DECEMBER 1, 1960

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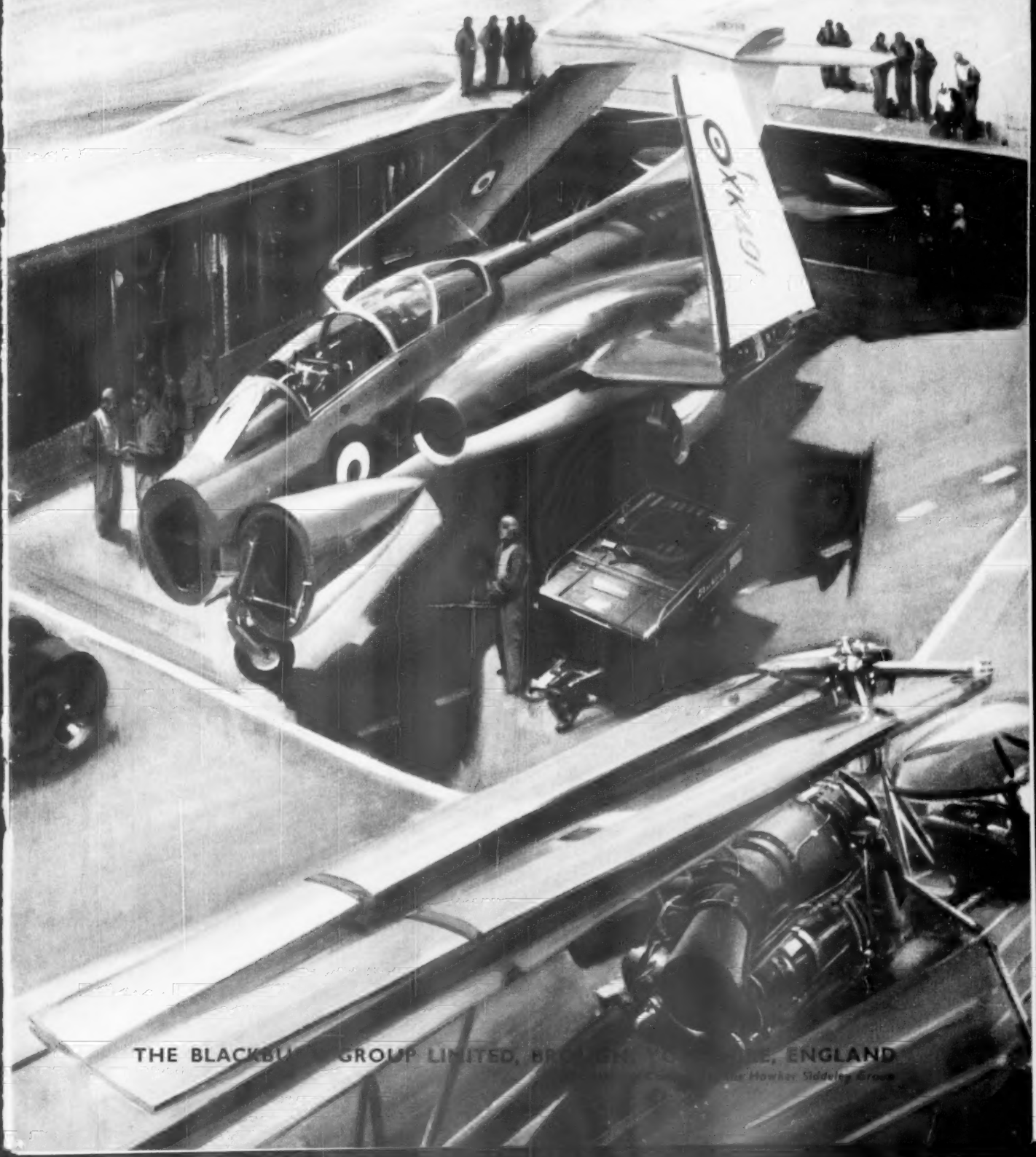

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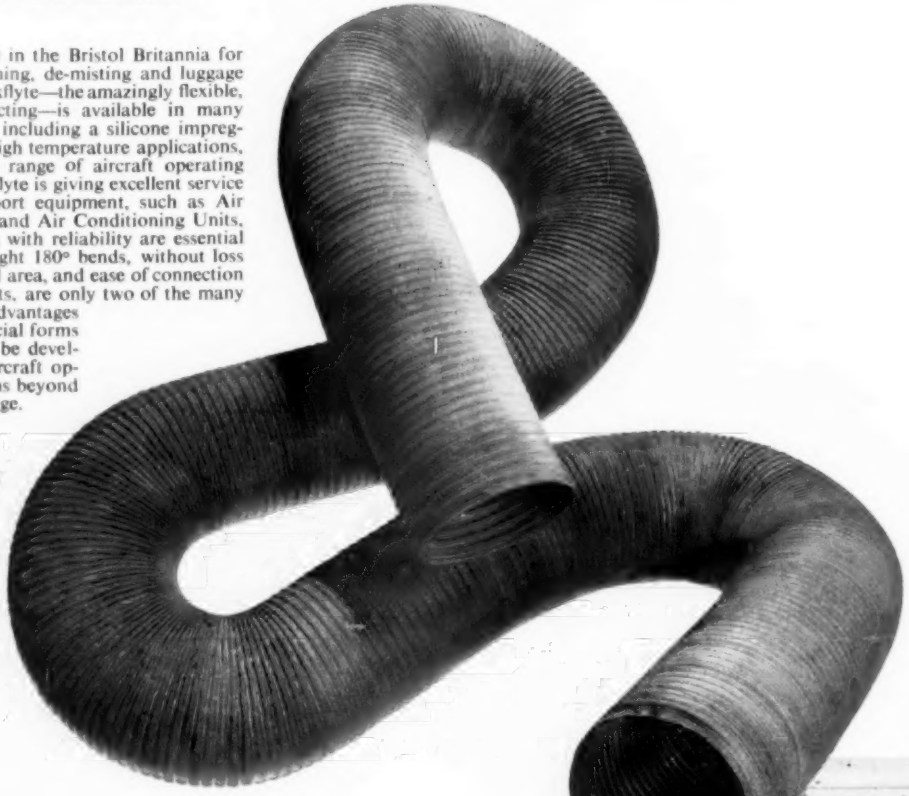

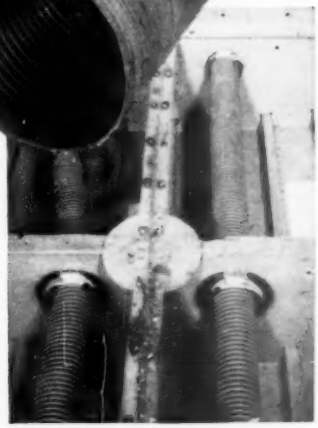

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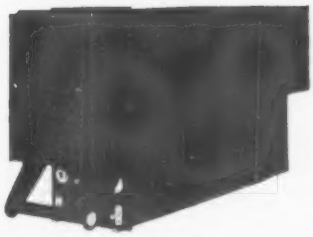

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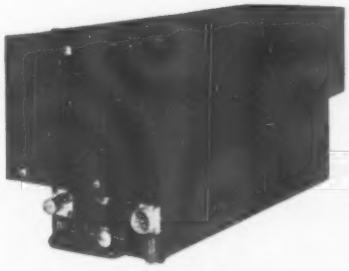

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Boeing 707 powered by Rolls-Royce Conway Engines—photograph by courtesy of B.O.A.C

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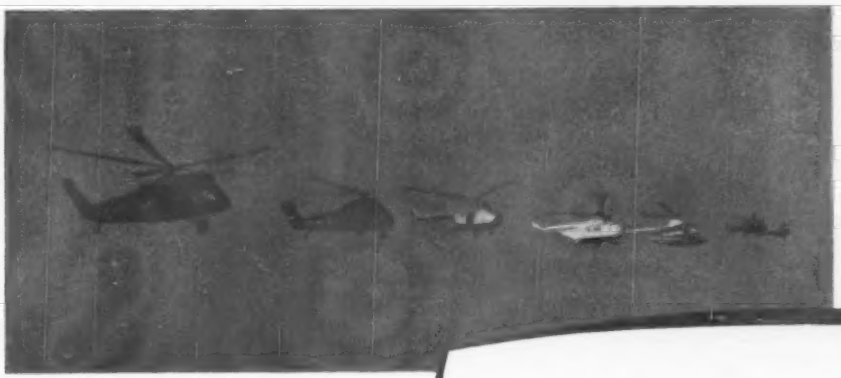

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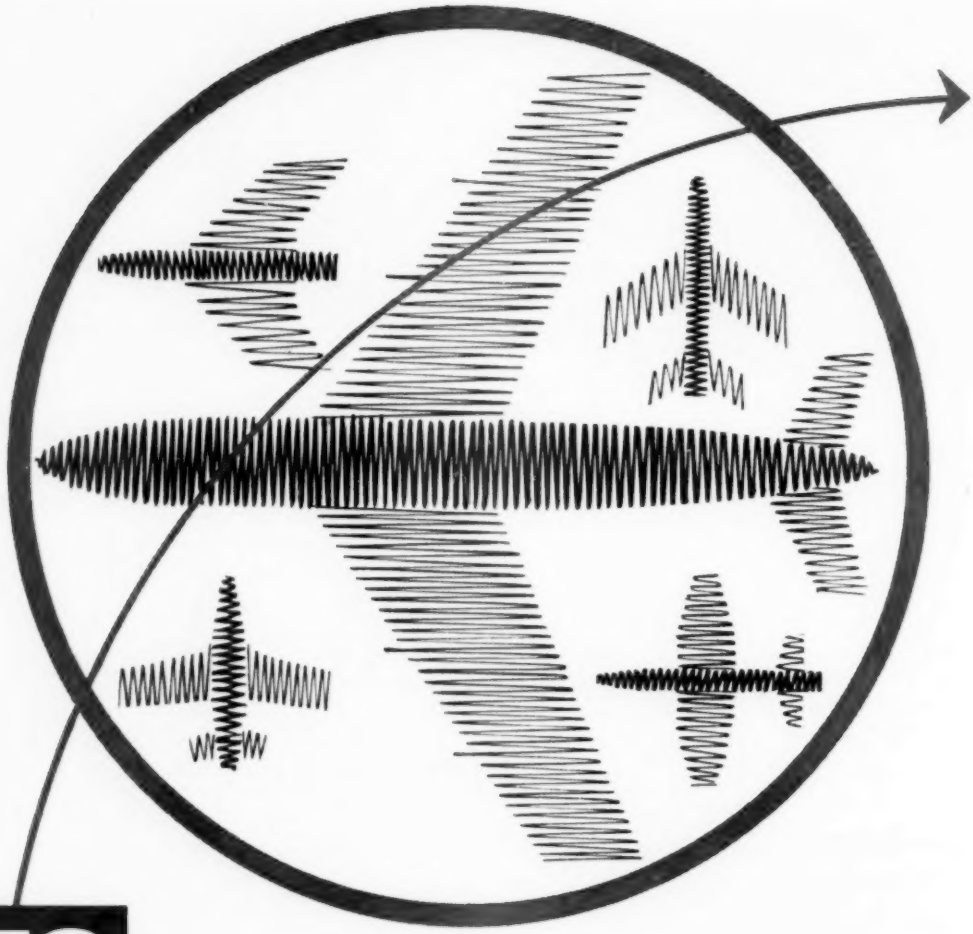

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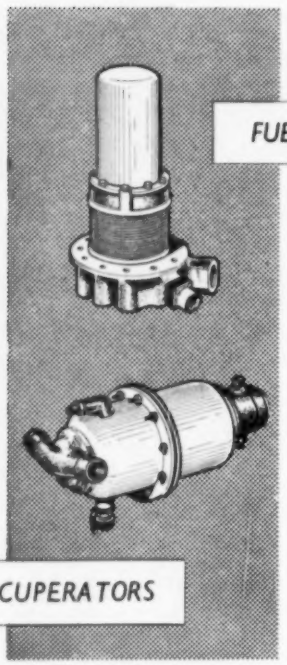

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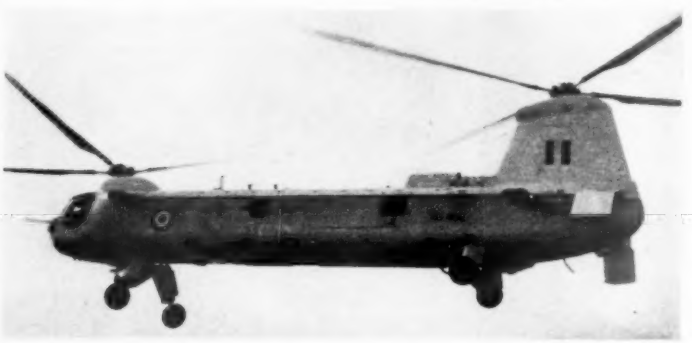

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THE AEROPLANE and ASTRONAUTICS

VOLUME 99 NUMBER 2564 DECEMBER 9, 1960

Space at Hamilton Place

In the ninety-sixth year of its life the Royal Aeronautical Society has built itself a fine new hall in London for lectures and social occasions. Well placed with its entrance in Hamilton Place and its back to the park, its flat roof will make a splendid venue for cocktail parties in the summer. Those who have expressed concern regarding its capacity—are 300 seats enough in these days of expanding technology—were certainly likely to find justification when they contemplated the overfilled spaces of the Society's headquarters last Friday night.

It was good to see that the British Interplanetary Society was well represented among guests and members. How far the term "aeronautical" covers the implications, from the semantic aspect, of "aerospace" we are not sure. But what matters is that the rising generation who are to make such good use of the new building shall keep their thinking firmly on the stars and the means of getting to them. Utilization by the B.I.S. of the new lecture hall will do much good from this point of view.

Look! No Wheels!

Once again the time has come round for our annual survey of vertical take-off capability aircraft. Since we began this review six years ago much progress has been made. Practical flying machines, either with swivelling airscrews or swivelling jet-engines, have demonstrated that vertical take-off can be obtained by means other than the helicopter rotor.

This year, for the second time, we have included a third range of vehicles and in our survey have reviewed British hovercraft achievements. At present most of the attention directed to these vehicles is concerned with their capability of providing transportation over the sea or unroaded terrain. It must not be forgotten that provision of an air cushion beneath an aircraft might render the undercarriage, and all that it implies, unnecessary.

Supersonic Propulsion

In the ever-changing aeronautical scene it is strange that so little attention has been directed to the situation now becoming apparent as regards aeronautical powerplants. Seeing that it was lack of a suitable powerplant which kept man out of the air for so many millenia and a similar lack which has prevented many good aeroplanes from being successes, we are for ever being surprised by the relaxed way in which planners regard powerplant development.

Recently, the internationally famous producers of aeronautical powerplants, Rolls-Royce, were persuaded to say something of their present position and their future plans. But among these facts (p. 756) one will search in vain for any mention of research or development on engines for supersonic powerplants.

Now it takes at least five years and perhaps £20 million to develop a modern gas turbine. It remains to see how long and how much it will cost to produce the engines for a supersonic airliner. Bearing in mind the proportion of earnings in British aeronautical exports now attributable to gas turbines, it is to be hoped that the Ministry of Aviation will see fit to initiate research on powerplants for a supersonic airliner right away.

Editor - THURSTAN JAMES
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Matters of Moment

Handley Page and the Future

A STATEMENT, issued last week, by Handley Page, Ltd., made it clear that the company was and is engaged in negotiations with an American company on many matters. "These," the statement emphasized, "do not include the sale of the company to American interests and it has received no offer and has no reason to expect any offer of this nature. It further wishes to state that it has never received from the Hawker Siddeley Group an offer of 17s. a share as referred to in the newspaper report."

It is, however, a fact that Handley Page has had discussions with the McDonnell Aircraft Corpn. and the company's secretary, Mr. J. H. S. Green, recently visited the U.S. for this purpose. A technical and commercial agreement between the companies was apparently discussed. In recent years there have been many links between American and European aircraft companies, often involving the U.S. company buying a minority interest in the European one. This gives the U.S. company a foothold in the European market, and also the possibility of lower-cost manufacture of its products in Europe as well as political advantages in selling these products.

A technical or commercial agreement of this kind between Handley Page and McDonnell would be no one-sided affair. As one of the most go-ahead of the smaller U.S. aircraft companies, McDonnell has a wide range of interests including Mercury satellite capsules, U.S. Navy fighters, the Model 119 utility jet transport, the Model 120 pressure-jet helicopter, the Quail decoy missile and production of airframes for the Talos surface-to-air missile. Most of its production effort is devoted to the F-101B Voodoo for the U.S.A.F. and the F4H Phantom II all-weather fighter for the U.S. Navy. Voodoo production will end soon, but work on the Phantom II should last for several years; the company is known to be interested in selling it abroad. The aircraft set up 100 km. and 500 km. closed-circuit records of 1,390 m.p.h. and 1,217 m.p.h. respectively last September. Phantom II orders are worth $369 million.

Handley Page production centres on the Victor 2 strategic bomber for the R.A.F. and the Dart Herald feeder-liner. The company has devoted considerable research effort both to laminar-flow techniques and to supersonics.

The key to any agreement may well be the Dart Herald. If produced or assembled in the U.S., it would give McDonnell a chance of entering the civil market. Fairchild in the U.S. has received no orders for the F-27 Friendship, an early competitor of the Herald, for a year and has nearly completed its production of this type. On the other hand, A. V. Roe are pressing on with the 748.

Handley Page could provide production capacity for McDonnell, should orders mature in Europe. There is also the possibility of extending Handley Page activities into the missile field.

PERSONALITIES AT BROUGH.—Mr. Barry Laight, director and chief designer of Blackburn Aircraft, explains a Buccaneer technicality to the Minister of Aviation, Mr. Peter Thorneycroft (right).

A.W.A. Board Changes

AFTER an association with the Hawker Siddeley Group which began in 1927, Mr. Claude S. Emery is to retire at the end of this year. For the past seven years he has been sales director of Sir W. G. Armstrong Whitworth Aircraft, Ltd., having joined the company in 1948.

Born in 1895, he was educated at Dean Close School, Cheltenham, and at the Education Training College in Munich. During the First World War he served with the Royal Fusiliers and in 1916 transferred to the R.F.C. From 1919 to 1927 he was chief flying instructor to the Baltic States Air Forces after which he became associated with the Armstrong Siddeley and Armstrong Whitworth companies. For these companies, and for A. V. Roe, he became northern and central European foreign manager in 1930 and in 1934 was appointed European manager for the Hawker Siddeley Group. In 1937 he rejoined Armstrong Siddeley Motors, Ltd., where he stayed until 1948.

In giving news of this retirement, the Armstrong Whitworth company also disclosed last week that Mr. C. Bayly, M.I.Mech.E., F.R.Ae.S.—hitherto an executive director and chief engineer of the armaments division—has been appointed director and general manager, which position became vacant when Mr. W. S. D. Lockwood was appointed managing director in September on the retirement of Mr. H. M. Woodhams. Mr. Bayly joined the A.W.A. aircraft production section in 1939 and the following year he joined the R.A.F., becoming officer in charge of a Fighter Command Headquarters Servicing Wing. He served for a year on Air Ministry special duties concerned with guided weapons and in 1946 transferred to the M.o.S. rocket propulsion department—as it was then—at Westcott.

The following year Mr. Bayly went to Australia where he worked on guided weapons until 1951 when he joined I.C.I. as rocket motor design manager. Rejoining A.W.A. in 1955 he was appointed chief project engineer for the Seaslug and in 1956 became chief engineer, armaments.

Mr. J. Dent, B.Sc., A.M.I.Mech.E., succeeds Mr. Bayly as chief engineer. He joins A.W.A. from Short Brothers and Harland where he has been chief engineer (guided weapons) since 1958. Prior to going to Belfast he was with the Admiralty.

Mr. F. D. Stallabrass, secretary of Armstrong Whitworth since 1947, has been appointed an executive director.

MEN IN THE NEWS.—Top, Sir Percy Hunting (left) chairman of the Hunting Group retires at the end of this year; he will be succeeded by his brother, Mr. G. L. Hunting (right) the present vice-chairman. Bottom, Mr. F. D. Stallabrass (left) is now an executive director of A.W.A. and (right) Mr. C. Bayly becomes director and general manager.

Courts Martial and the R.A.F.

IN moving approval of the Air Force Act 1955 (Continuation) Order, 1960, the Secretary of Sate for Air, THE RT. HON. JULIAN AMERY, gave some interesting figures redounding to the credit of the R.A.F. as a body. Early in his discourse he touched on Courts Martial. Courts Martial always make news in and out of the Service, and in the Service they fall to be regarded sometimes with a certain amount of levity by those not involved at the receiving end.

Considering, however, that R.A.F. personnel are subject as citizens to the ordinary laws of the land in addition to those peculiarly incidental to their Service discipline (a fact often overlooked), the incidence of prosecution is progressively decreasing and is now remarkably low when matched against those of most comparable corporate bodies. The overall figure for 1960 is 2.7 per 1,000 of all officers and other ranks, falling from 3.3 in 1959 and 3.5 in 1958. This steady decrease may be due, in part, to the fact that the average length of engagement is going up, with consequent heightened sense of responsibility—at present nearly two-thirds of all members of the R.A.F. are serving on a nine-year engagement or longer.

Perhaps even more telling is the news that during the year under review throughout the R.A.F. at home and abroad not a single breach of flying discipline occurred warranting Court Martial action. When it is realized that 80% of all flying over the United Kingdom, including British and foreign air lines, is done by the R.A.F., this is a fine record indeed.

John Brancker's New Venture

FROM Montreal comes news of the formation of a new company, Consultair, Ltd., with Mr. John W. S. Brancker as its director. The company has its offices at 4870 Cote des Neiges Road, Montreal, and its aim is to provide consulting and advisory services in aviation, tourist promotion and traffic development.

John Brancker's sudden departure from his post as traffic director of IATA earlier this year was much regretted by many airlines. He had been with IATA since 1953, and had previously represented B.O.A.C., as its general manager, international affairs, at IATA Traffic Conferences. He has served also in various capacities with Imperial Airways and B.E.A., and has been vice-president of the Institute of Transport and a member of the Board of the British Travel and Holidays Association.

Loss of Sputnik VI

AFTER orbiting the Earth for about 24 hours, the third Soviet spaceship, Sputnik VI, burnt up in the atmosphere on the morning of Dec. 2 after responding to a command signal to return. It carried to destruction two dogs, Pchelka (Little Bee) and Mushka (Little Fly) and "other animals, insects and plants." The Russians said the spaceship descended along "an incorrect trajectory."

Observers in the West had expressed concern over the satellite's fate before recovery was attempted because of its low orbit. Comparative figures for the three similar vehicles launched to date are given on page 761.

In an interview published in the newspaper *Izvestia*, Prof. A. Blagonravov said the third spaceship was even more highly instrumented than the second one and the programme of research was increased accordingly

"Supplementary data was obtained of the design of the ship, the functioning of its separate units and systems and the work of the sources of energy on board. The test-results transmitted to Earth confirmed that the systems designed to secure subsequently the necessary conditions for normal life of man in flight, air conditioning, heat regulation, and communications, functioned quite reliably."

The question now is whether the Russians will undertake more intensive re-entry experiments, with or without test animals, in order to fulfil their "man-in-space" objectives at a reasonably early date.

SOCIETY MAN.—Capt. Laurence Pritchard, Hon. F.R.Ae.S., Hon. F.I.A.S., for twenty-six years (1925-1951) secretary of the Royal Aeronautical Society, was present at the opening of the new R.Ae.S. lecture theatre last Friday (see P. 754).

Hugh Conway photograph

Sounding Rockets for Sweden

A LETTER from Mr. Ake Hjertstrand, a founder of the Swedish Interplanetary Society, informs us that the Swedish Space Research Committee are to receive five American Arcas sounding rockets as a gift.

Initial firings are to take advantage of an already established missile range in the north of Sweden. Investigations are under way for a possible future, purely civilian, site reasonably close to the Kiruna Geophysical Observatory.

Mr. Hjertstrand says it is "rather premature" to comment upon a possible co-operation with Norwegian circles, although this has been widely forecast.

DELIVERED.—On Dec. 2, the Vickers Vanguard was granted its C. of A. (see page 757) and the first aircraft was delivered to B.E.A. Left to right, in front of G-APEE here are Capt. M. R. Chick, Capt. A. S. Johnson (B.E.A. Vanguard Flight Manager), Mr. E. B. Trubshaw (chief test pilot) and Mr. M. C. Crisp (flight test manager).

Realization of an R.Ae.S. Dream

A LARGE "family gathering," which included some of its most distinguished members, saw the formal opening of the Royal Aeronautical Society's fine new lecture theatre, by Lord Brabazon of Tara, P.C., G.B.E., M.C., Hon.F.R.Ae.S., on Dec. 2. This was, indeed, a moment of aeronautical history and a great occasion for the Society and its members. The house at 4 Hamilton Place was crowded; at least 10 past presidents were there and a list of the names of those present would seem like pages out of "Who's Who in Aviation." Some 310 members and their ladies were seated for the ceremony in the theatre itself, while about 170 others were able to watch from the ante-room and council chamber on closed-circuit television screens.

Cables of congratulation were received from the South African and Australian Divisions; the Canadian Aeronautical Institute; the Institute of Aerospace Sciences; and from Dr. Theodore von Kármán, chairman of AGARD. The Canadian institute, with whom the R.Ae.S. has a close affinity, expressed the warming hope that the theatre might always be found to be too small.

LORD BRABAZON said that he was readily aware of the fact that he had been selected for the honour of opening the new theatre "by virtue of my disastrous longevity." (He was the Society's president a quarter of a century ago.) He referred to the fact that the R.Ae.S. is nearing its centenary and to the outstanding events that have taken place during its history. The latest was the building of its own lecture theatre—or to use Lord Brabazon's most fitting phrase "this splendid place."

He sounded a warning against complacency. This great Society, he said, alive and virile, was not dwelling on the past but looking to the future. In the new hall there would be discussions between young and imaginative people and the ideas that would be born in it would help to maintain our lead in World aviation.

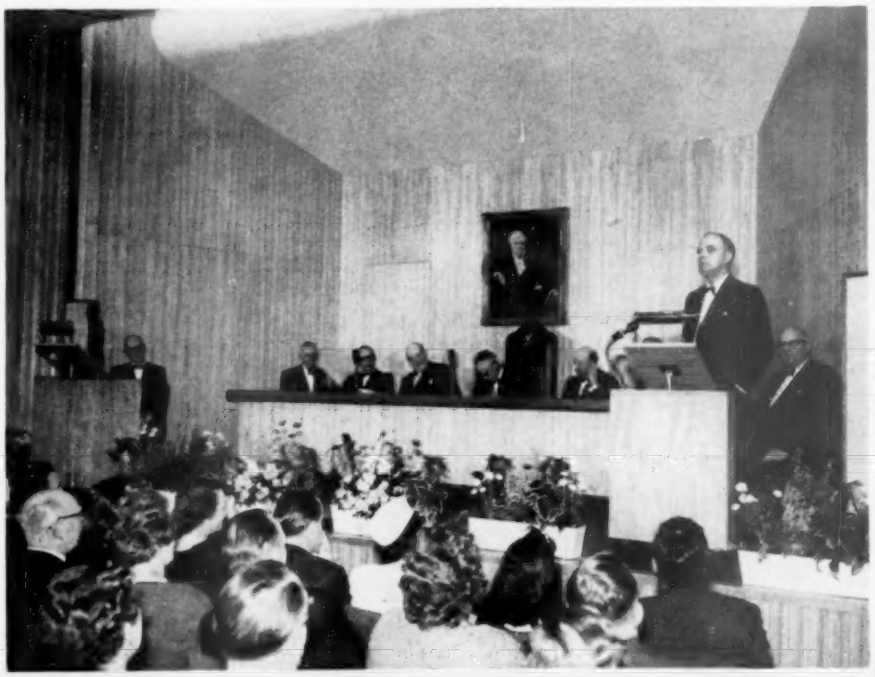
It fell to MR. W. GORDON WILSON, chairman of the Graduates and Students' Section and the youngest member of council, to propose a vote of thanks to Lord Brabazon. In doing this, he added a rider and thanked the Society for providing a facility which in the main would be for the benefit of the younger generation. He referred to Lord Brabazon as one of the most accomplished members of aviation and spoke for everyone when he expressed warm appreciation for everything he had done for the aeronautical community.

It was most fitting that the first lecture to be given in the new theatre was given by the president DR. E. S. MOULT, C.B.E., Ph.D., B.Sc.(Eng.), M.I.Mech.E., F.R.Ae.S. This took the form of an extremely interesting account of the background story of the lecture theatre project, of its building and its features. Dr. Moult's talk was illustrated with a number of slides which, he explained, were of various sizes and qualities to demonstrate the capability of the projection apparatus which is the most advanced at present installed anywhere. Certainly the result was first-class; and many people were glad to note that despite the modernity of the projector, it also incorporated the traditional technique of showing at least one slide inverted.

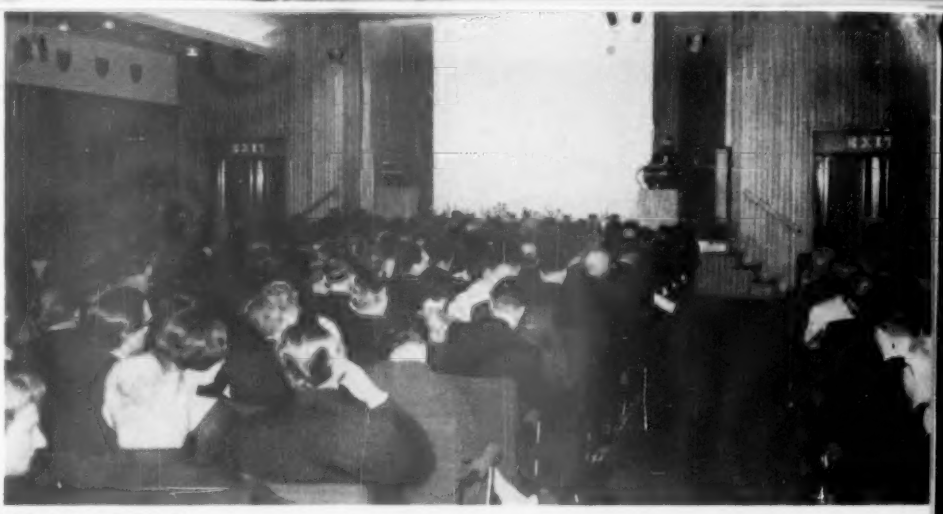
The lecture ended with a short film to demonstrate the properties of the theatre's 16-mm. sound projection apparatus. The film, "Realisation of a Dream," also described the background and building of the lecture theatre.

After this short educational session, Dr. Moult called to the platform those who had much to do with its inception and creation—Sir Arnold Hall; Sir George Edwards; Mr. P. G. Masefield; Major G. P. Bulman, the Society's treasurer; Mr. A. H. Lee and Mr. A. L. Luke, directors of the firm of architects; and Dr. A. M. Ballantyne, the Society's secretary.

DR. BALLANTYNE then had something nice to say about each of these contributors to the project and presented them with



Right, Dr. A. M. Ballantyne making his speech of thanks to those responsible for the new lecture theatre who were on the platform with the president and Lord Brabazon. Below, members and guests enjoying the buffet supper which followed the opening ceremony.



Right, the president giving the first lecture in the new hall and describing its background story. Below, the president, Dr. E. S. Moult (centre) with Lord Brabazon on his left and the R.Ae.S. secretary Dr. A. M. Ballantyne.

Photographs copyright "The Aeroplane and Astronautics"

handsome cuff-links, bearing the Society's crest, as a memento.

And finally Lord Brabazon had the last word. His recorded voice was played back and for the second time that evening the new hall was declared open.

From the point of view of the audience there can be no doubt that the R.Ae.S. Lecture Theatre is one of the finest. On this particular occasion several members arriving especially early spent a good two hours in their seats and suffered no discomfort—even though the seating is of a relatively high-density layout. The air conditioning system works admirably; smoking is permitted and to a non-smoker it was not at all noticeable. Every word spoken was easily heard—including the quietest of asides—and the acoustics appeared to be excellent. The lighting is discreet and the general decor extremely restful and pleasant.

Indeed, the only point of criticism heard was that the portraits of past presidents around the hall were rather too uniform. Moreover, it seemed a pity that, so far, only the most recent have been selected for honour in this way.

However, be that as it may, the oldest aeronautical society in the World now has a new addition to its home of which many other learned institutions will be extremely envious. Those who had the courage to go ahead with the project; those responsible for its planning and design; and all those who contributed to the fund, are to be congratulated.—F.T.M.

Club Flying and the R.A.F.

IT seems a long time since the value of club flying to military aviation was acknowledged in this country. When such a recommendation comes from the C.-in.-C. Flying Training Command of the R.A.F., as it did last week during the A.B.A.C. Dinner (reported on p. 785) its value is immeasurably enhanced.

In affirming the continuing reliance of the R.A.F. on manned aircraft, Air Marshal Sir Hugh Constantine left no doubt in his listeners' minds as to the unprecedented quality of its aircrew recruits demanded by the R.A.F. The difficulties of getting the right type of man were emphasized by the requirements for a 50% increase in numbers, compared with an acceptance rate of 10% of aircrew applicants at the Hornchurch Selection Centre, and their subsequent 50% wastage.

Attrition during training is inevitable, but with today's all-through jet instruction, and the Jet Provost having six times the operating cost of the Chipmunk, wastage must happen at the earliest possible stage. In that respect, R.A.F. experience was highly significant in that post-selection wastage of club-trained flying scholarship cadets was about 16%, whereas among selected aircrew applicants from Hornchurch with no previous air experience, the comparable figure was nearly 50%.

Air Marshal Constantine's bouquet to the clubs was therefore well deserved and may be regarded as an effective answer to the Treasury attempts to remove the petrol-tax rebate—a little enough form of subsidy, in all conscience. But his conclusion that it might well be necessary to reintroduce the Chipmunk into Initial Training Schools (like the wartime Grading Schools), to ensure an early and economical elimination of unsuitable trainees surely takes the whole process a stage further.

Here is a job which, it seems, the clubs could do extremely well, almost undoubtedly cheaper than the R.A.F., and freeing Service aircrew for more operational tasks. Suitable training standards in our flying clubs for scholarship cadets are already assured by visiting teams from C.F.S., who have visited 15 to 20 of them this year. If R.A.F. Chipmunks were released to the clubs for Service use, they could be operated under civilian flying and maintenance contracts as was the case with the sadly defunct R.A.F.V.R., and is still the case with the University Air Squadrons.

At one stroke, this would also disarm the Treasury threat against the U.A.S., all 17 of which were taken over last year by Flying Training Command from the former Home Command. These have some 860 members, and although their contribution rate to R.A.F. aircrew recruiting is probably fairly low, their total contribution to Service-mindedness at our intellectual centres is invaluable.

Since the U.A.S. also use Chipmunks, and their members fly only 40 hours a year, a more economical utilization could be achieved by their using the same aircraft for R.A.F. grading or selection flying. Their operation by the flying clubs would give these greatly increased financial stability, and while it may not be possible to extend flying benefits to other club members, it might prove possible for all costs to be lowered instead of inexorably increased, as in the past.

Air Marshal Constantine spoke of the need for a unified control system to make the optimum use of available airspace for civil and military aircraft; a unified light aviation movement would be an excellent start to that aim.

Uncle Sam's Trident

TWO AND A HALF years after the announcement of the D.H.121, later named the Trident, the Boeing Company has announced contracts worth more than $350 million for the supply of 40 Boeing 727 short-range 70-114-seat jet transports each to Eastern Air Lines and United Air Lines. The United order is at present firm only for the first 20. The design, so closely resembling the D.H. Trident, which is to fly next year, is notable as the first Boeing design not to have engines in wing-pods.

Background of the 727 project was discussed in our previous issue (page 733) and the illustration alongside shows the salient points of the design. Studies began about 4½ years ago and 150 different projects were analysed in detail. Design objectives were to use 707-720 series tooling wherever possible in order to keep costs down, and to use proved 707 systems. Average direct costs of the 727 on a 500-mile sector are about $1.50 per aircraft mile.

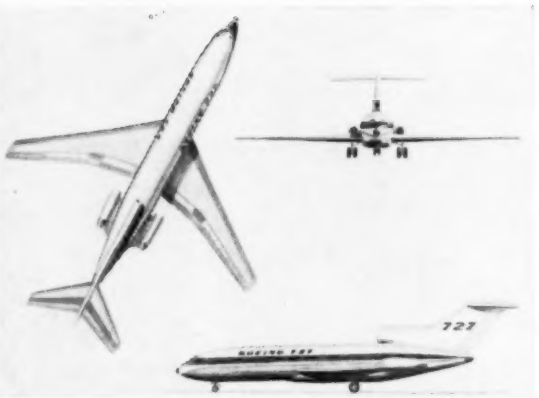
Good low-speed performance is obtained by the use of triple-slotted trailing-edge flaps and slats (outboard) and flaps (inboard) on the leading-edge.

Power Plant: Three 14,000 lb.s.t. Pratt & Whitney JT8D-1 turbo-fans with thrust reversers.

Dimensions: Span, 108 ft.; length, 134 ft. 1 in.; height, 33 ft. 9 in.; fuselage outside width, 12 ft. 4 in.; sweepback, 32° at quarter chord; cargo hold height 44 in.; cargo volume, 850 cu. ft. in two holds; fuel capacity, 7,000 U.S. gallons.

Weights: Operating weight empty, 81,000 lb.; payload, 24,000 lb.; max. take-off weight, 142,000 lb.; max. landing weight, 131,000 lb.

Performance: Speeds "same as 707." Field length required, "5,000 ft. with full payload." Operational range capability "up to 1,700 st. miles."



Rolls-Royce Today and Tomorrow

SINCE the first Rolls-Royce turbine-powered passenger-carrying aircraft, the Viscount, went into regular airline operation with B.E.A. in April, 1953, more than 1,000 civil aircraft powered by Rolls-Royce gas turbine engines have been sold. This means that out of a total of approximately 1,760 civil aircraft with turbine engines which have been sold up to the present in the Western World, nearly 60% have been ordered with Rolls-Royce engines. Of the latter 1,009 aircraft 621 are British-built, 192 American, 94 French, 85 Dutch and 17 Canadian.

About 80% of the civil turbine engines ordered are for overseas customers and a similar proportion of the consequent spares business. This has made an ever-growing contribution to the £230 million worth of export business done by Rolls-Royce since 1953 and to exports which are currently running at nearly £55 million a year.

The engineering effort involved in developing the six different Rolls-Royce civil engines has been, and still is, immense. Out of a total strength of 35,000 on aero-engine work—more than 8,000 people are fully occupied in the research and development organizations. The production effort involved has also been large, and has extended facilities to the limit.

In addition to the four Rolls-Royce companies which have been founded in Canada, Australia, Brazil and the U.S.A. there now exist 24 overhaul shops for Rolls-Royce gas-turbine engines in 17 different countries. There are over 300 service engineers stationed in 35 countries throughout the World to serve the 68 airlines and 76 other operators using Rolls-Royce civil engines.

The development and launching costs of a modern large aero engine are about £20 million and about equal to those of the airframe in which it is fitted. Clearly such an investment is unlikely to be recovered from a single aircraft project and emphasizes the importance of harmonizing civil and military requirements. This explains why Rolls-Royce make such efforts to have their engines chosen for more than one aircraft.

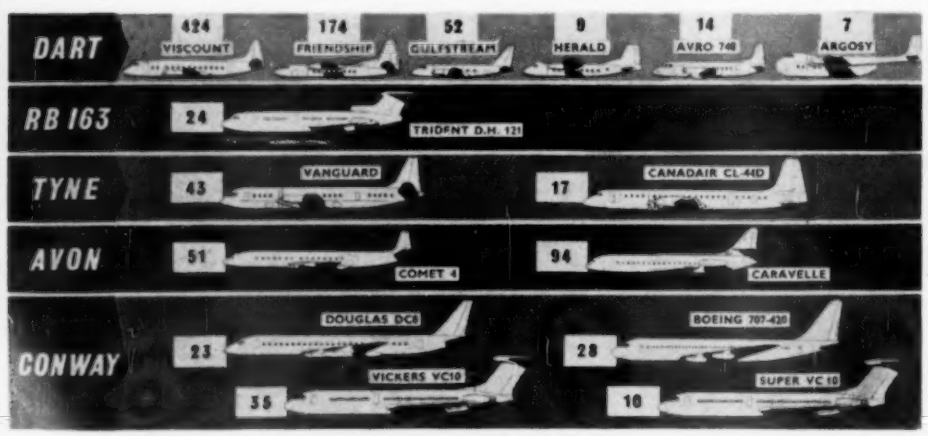
For many years yet Rolls-Royce foresee that their main business will be engines for subsonic aircraft. And here the company is in the enviable position of having pioneered the by-pass type of engine which is going to power the future large civil aircraft of the World, at least until the supersonic era.

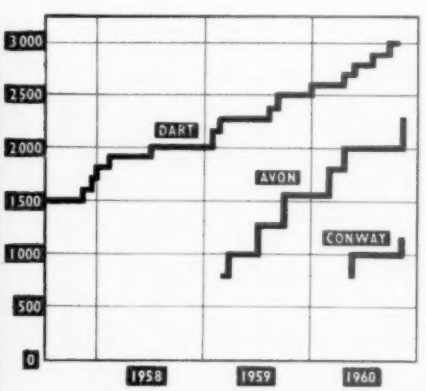
The company has now embarked on the second generation of by-pass engines. Rolls-Royce consider it is of interest that their main World competitor in America is developing for the Boeing 727 an engine of almost exactly the same technical specification as the Spey (RB.163) as regards by-pass ratio and compression ratio. It was not until the success of Conway that we began to hear much about American fan engines.

Recently, the deputy chairman and managing director of Rolls-Royce, Ltd., Mr. J. D. Pearson, issued a warning that if these assets are to be used to the best advantage there must be the closest relationship with the Government. There must be boldness and recognition of the risks, discrimination but quick decisions. The creation of the Ministry of Aviation was welcomed as were pronouncements of succeeding Ministers.

Mr. Pearson interpreted their remarks to mean helping those who by their initiative and enterprise and willingness to invest substantial sums, have shown their ability to succeed in the export markets—because there comes a time when even they find that, despite their success, the risks and finance required for the continuing exploitation of their position are beyond their own capacity.

A subsequent announcement by the Minister of Aviation disclosed that a financial contribution was in fact being offered for development of the RB.163.





WORLD-WIDE SALES.—Left, how the five types of Rolls-Royce turbine are distributed in numbers of aircraft sold. Since the chart was drawn the RB.163 has been named the Spey. Right, a graph showing how engine hours go up with use.

Air Transport

The Vanguard's C. of A.

AN unrestricted passenger-carrying certificate of airworthiness was awarded by the A.R.B. to the Vickers Vanguard 951 (B.E.A.) and 952 (T.C.A.) on Dec. 2. On the same day, B.E.A. accepted delivery of the first of their six 951s (G-APEE), flying it to Stansted for crew training to begin. The Corporation has nine training captains qualified on the Vanguard at present, and 10 more pilots are now being trained at Stansted. Delivery of the next Vanguard to B.E.A. is scheduled for Dec. 17, and from that date the aircraft will be available for use on an *ad hoc* basis on scheduled services as and when the training programme permits.

The Vanguard is the first aeroplane certificated from the outset to the current (1959) B.C.A.R.s. The Flight Manual for the T.C.A. version, which is the basis of the Vanguard II now on offer to other operators, shows that Vickers' guarantees in respect of take-off, climb-out and landing performance have been significantly improved, while the climb and cruise performance estimates have proved exceptionally accurate. An example of the "performance bonus" is that the allowable take-off weight for a 5,000-ft. runway in I.S.A. is 135,000 lb., compared with the estimated 122,000 lb. Use of the Collins autopilot in the Vanguard 952 is temporarily restricted and tropical validation has still to be obtained.

Certification of the Vanguard followed completion of the engine assurance test flying described in our issue of Nov. 4. Between Oct. 6 and Oct. 31, Vanguard G-APED flew a 200-hr. test programme at an average annual utilization rate of 2,900 hr. to a simulated airline pattern, completing the test three days ahead of schedule.

B.O.A.C. to Los Angeles

STARTING date for B.O.A.C.'s long-planned service to Los Angeles will be Mar. 2 next year, at a frequency of twice a week. Using Boeing 707-436s, the Corporation hopes to achieve non-stop operations eastbound from Los Angeles on about 85% of occasions. Montreal will be used as a refuelling stop when necessary eastbound and on all westbound services, but the Corporation has no traffic rights between Montreal and the U.S. West Coast.

Scheduled elapsed times are 14 hours westbound (leaving London at 13.00 G.M.T. and arriving Los Angeles at 19.00 local) and 11 hours eastbound (leaving at 22.00 local and arriving London at 17.00 G.M.T. next day). The aircraft will be arranged to carry 32 first-class and 97 economy-class passengers initially, this ratio changing to 24/111 in the summer peak. Fares will be £243 8s. single and £451 1s. return first-class and £143 15s. single and £269 8s. return economy-class.

A B.O.A.C. 707 was demonstrated in Los Angeles for the first time towards the end of November on the return leg of the transpacific proving flight (JPF022) to Tokyo and Hong Kong. Considerable interest in the B.O.A.C. service—which will compete with Pan American and T.W.A.—has already been aroused and several hundred applications for tickets have been made.

Moving to Gatwick

UP to a third of B.E.A.'s London-Paris services may use Gatwick instead of London Airport from Mar. 1, 1961, when the Vanguard goes into regular service on the route. In a move to relieve congestion at London Airport, the M.o.A. has also asked Air France to move half of its Paris services to Gatwick. Last week an Air France spokesman said it would "strongly resent" being made to use Gatwick; and added "passengers coming from Paris on the Caravelle in 45 minutes would take from two to two and a half hours to reach their London hotels."

The Air France opinion seems to be unduly pessimistic. We calculate that the time from touchdown to arrival at Victoria would be two hours under the worst conditions (40 minutes for deplaning and Customs, 20 minutes wait for train and one hour on a slow train), but with reasonable luck and a fast train would be about an hour and a quarter.

Average times from touchdown at London Airport to, say, Piccadilly are around 1¼-1½ hours. These calculations exclude the intangible advantages to be gained from Gatwick's freedom from traffic congestion, the slightly shorter flight times from the Continent and generally shorter taxi-ing times.

Probably the biggest problem in using Gatwick is that of the interline passenger wishing to make a connection at London Airport. The coach journey between the two airports takes two hours, and it is likely to be several years before a helicopter service can be provided with the required reliability.

According to the M.o.A., 11 airlines now use Gatwick regularly (these include B.E.A., Jersey Airlines, Sudan Airways and various British independents). Estimated passenger movements for 1960 are 475,000, compared with 367,850 last year.

Mexico's "Air Union"

FORMATION of an equipment-sharing consortium by the three Mexican international airlines has been proposed as the latest solution to these operators' financial difficulties in purchasing jet transports. Previously, Aeronaves and Mexicana, two of the three airlines concerned, had discussed a merger, and the possibility of Guest Aerovias, the third airline, becoming involved also in a single national airline has been rumoured.

Mexicana became the first of these operators to obtain jet equipment, with its purchase of three Comet 4Cs. The first was delivered last January but services were delayed by a long pilots' strike. The third Mexicana Comet left Hatfield on Nov. 29 for Mexico City.

Aeronaves, a Britannia operator, recently purchased a Douglas DC-8, obtaining almost immediate delivery by arrangement with Eastern Airlines, which relinquished a production-line position to Aeronaves. This Mexican operator is reported to have ordered two more DC-8s for 1961 delivery. Guest Aerovias has no jet equipment.

By forming an equipment consortium and sharing the use of a common fleet, the three airlines believe they could achieve useful economies and would require fewer aircraft than the total of three individual fleets. The question of equipment is the most difficult one remaining to be solved, in view of the discrepancy between the types already in use and the need to standardize on a single type to gain maximum advantage from the scheme.

Eurocontrol in the House

REPLYING to a question by Mr. de Freitas on Nov. 24, Mr. R. A. Butler told the House of Commons that the Minister of Aviation was expected to sign the Eurocontrol Convention in Brussels this month, and that joint military-civil control of upper air-space (over 25,000 ft.) over the whole of the U.K. would be complete in 1961. All civil and military aircraft flying the airways system up to 25,000 ft. in the U.K. are already under the control of civil air traffic control centres.

On Nov. 28, Mr. Rankin asked for more information about the main provisions of Eurocontrol. It provided, said Mr. Thorneycroft, the Minister of Aviation, for the setting up of a permanent commission for the safety of air navigation, and an air traffic service agency which will be responsible for providing air traffic control service in the upper air-space of France, the Benelux countries, Western Germany and the U.K.

Both these answers made it clear that the situation at lower levels is still far from satisfactory, as Mr. Rankin went on to point out. The answer to his further question about steps being taken to improve safety at these lower limits was a typical piece of bureaucratic gobble-de-gook. Mr. Thorneycroft said:—

"The first step to take is to make quite certain that in this country we are taking all the urgent steps that are required to have a fully integrated civil-military aircraft system for the control both of civil and military aircraft. In consultation with my hon. friend the Secretary of State for Air, we are, I am happy to say, progressing very rapidly towards that situation."

The New Regulations

FOLLOWING the coming into force of the new Civil Aviation (Licensing) Regulations, 1960, on Dec. 1 (as we noted briefly last week), the Air Transport Advisory Council has stopped accepting applications for air service licences. It will continue to process the applications already received and, for the next four months, will deal with any emergency amendments to existing licences. The Air Transport Licensing Board is now open to receive applications for licences for services to begin on or after Mar. 30, 1961, the date on which the main provision of the 1960 Act will come into force.

Details of the Regulations were published in our issue of Jly. 29, and of the fees to be charged for air service licences in that of Sept. 30.

Air Transport . . . .

Signed, Sealed and Delivered

An account of acceptance procedures at Seattle and the delivery flight of a Boeing 707-436 for B.O.A.C.

B.O.A.C. opened its technical office at Renton, home of Boeing's Transport Aircraft Division, in November, 1956, when the contract for 15 Conway-engined 707-436s was signed. To take charge of this office, Ivor Lusty, the Corporation's West Coast technical consultant, moved up from Santa Monica, where he had been looking after acceptance of the 10 B.O.A.C. DC-7Cs. With him went Hugh Hamblin, assistant plant representative, and J. C. Collins, liaison engineer (since succeeded by Bill Dyer).

Inspectors were assigned to the Boeing plant as soon as hardware for the B.O.A.C. aeroplanes began to appear in the shops—in August, 1958. The inspection team reached a seven-strong peak in December, 1959, since when it has been tapering off. The first flight of a B.O.A.C. model 707-436, on May 19, 1959, brought with it the need for a B.O.A.C. technical pilot at Seattle—a post filled by Capt. H. J. "Dexter" Field, who has been responsible for the acceptance testing of the aircraft.

Boeing test flying on each production aeroplane occupies anything from the contractual minimum of three hours to a maximum of about 10 hours, and begins on the first flight, which originates at Renton and terminates at Boeing Field, a few miles nearer to Seattle. Here, the Boeing Flight Test Centre clears any snags and submits the aeroplane for an F.A.A. acceptance flight, of about two hours' duration, without which the F.A.A. airworthiness certificate cannot be issued.

Under the arrangements made between the F.A.A. and the A.R.B. for the mutual validation of each other's certificates, the F.A.A. issues an airworthiness certificate of export, which says that the aeroplane would be certified for domestic U.S. use and also complies with any other special requirements set up by the importing country.

In the case of the B.O.A.C. 707, the A.R.B. laid down 23 special conditions. This sounds a comparatively short list, but as a single special condition might be something like "compliance with B.C.A.R. performance section," quite a lot of work was entailed in meeting these conditions. A further problem, in practice, lay in the way in which the conditions were interpreted. In the case of performance, for instance, the F.A.A. had little choice but to follow to the letter the appropriate B.C.A.R.s indicated by the A.R.B., whereas the A.R.B., in certificating aeroplanes, tends to use a great deal of discretion in applying the regulations. The 707-436 was duly certificated by the F.A.A. to the complete satisfaction of the A.R.B. at the end of April, 1960. Up to this time, Boeing had flown 199 hours on the -436 and the F.A.A. testing totalled 59 hours, including 28.6 hours on tests specifically to meet A.R.B. requirements.

Jet]Speedbird No. 13, G-APFN, leaves Boeing Field, Seattle, on its pre-delivery acceptance flight.

Ivor Lusty (centre) completes the purchase for B.O.A.C. of the Corporation's 13th 707 by handing over $3,850,000, and receives in exchange the bill of sale from Boeing's contract administrator, Serge Gorny.

On the production aircraft, as soon as the F.A.A. has flown the aircraft, a B.O.A.C. acceptance flight is made. Normally of about two hours' duration, this covers, among other things, flight in all the modes; a speed check; flight up to VNE; an emergency descent, cabin depressurization; emergency gear down; a check of the auto-pilot through all phases; a VOR approach; and fuel dumping. On board, in addition to Capt. Field, are a flight engineer, a communications officer, the B.O.A.C. liaison officer and a group of inspectors. If all is well, the aircraft is accepted, and is prepared for delivery. Ten of the first 13 aircraft were, in fact, accepted on the first flight.

To meet A.R.B. requirements, a daily inspection has to be made between the acceptance flight and the delivery flight. A certain amount of paper work also has to be completed. In the first place, the A.R.B. certificate of airworthiness has to be obtained, so that it can be placed on board for the delivery. This vital piece of paper cannot be issued to B.O.A.C. until the F.A.A. airworthiness certificate for export is produced and, in order to save time, arrangements were made, after initial certification and acceptance of the first -436, for all the A.R.B. certificates to be held by the British Consul-General in Seattle.

Responsibility for accepting the aeroplane lies, ultimately, with the senior B.O.A.C. representative at Renton, Ivor Lusty, acting for the chief engineer. As soon as he is satisfied with the report of the inspectors and the acceptance flight, he indicates his willingness to "buy" the aeroplane and arranges to meet Boeing's contracts administrator to complete the essential paper work.

This process has been reduced to a well-organized routine—Boeing has, after all, participated in this particular little ceremony more than 170 times already. After formally establishing their credentials, the B.O.A.C. and Boeing representatives (the latter led by Serge Gorny, contracts administrator) proceed to sign the aircraft readiness log. This, and miscellaneous record documents, are then handed to B.O.A.C., together with

(*Continued on page 759*)

Barging up the Rhine in winter

To the wine lover and the holiday maker, the Rhine brings to mind scenes of sunshine, deep terraced gorges and romantic castles. To the oil tanker skipper, however, the Rhine can present quite a different picture. For four months of the year, ice, snow, floods and fog continually hamper navigation. But, come what may, the loads must get through, for the Rhine is the prime fuel supply route to the airfields of Switzerland.

Weather conditions are not the only obstacles. On the lower stretch, from Rotterdam to Cologne, traffic is dense. Strong currents and changing water levels increase the difficulties of navigation on the upper reaches and at one point a river pilot takes command. Above Coblenz, the river funnels through the famous, narrow gorge and the tankers must often make two trips to get their heavy loads up the rushing torrents. On the last stage to Basle, the river bed climbs steeply through the mountains and rises by some 400 feet in altitude. Here again, when water levels are falling, the ships are lightened. Sometimes by as much as two-thirds. There are low bridges to watch at high water; shoals and banks to watch at low water. The Skipper's work is never done. But one consolation — at nightfall all traffic on the Rhine must stop.

Perhaps the 500-mile journey up the Rhine is not the *easiest* route to Switzerland. But it is the most economical and satisfactory. Especially with the modern radar equipped tankers now in service. All over the world, wherever aviation fuel is needed, Shell will find the best way to supply it — regardless of the effort involved.

SHELL

you can be sure of Shell

These illustrations show, actual size, some of the Timken bearings used in aircraft

From left to right, top row, these comprise

1. *Blade root bearing for variable-pitch propeller.*
2. *Bearing for an airborne instrument mounting.*
3. *Helicopter rotor torsion hinge bearing.*
4. *Bearing for spider mechanism controlling cyclic pitch of helicopter main blades.*

Bottom row, left to right:

5. *Bearing for variable-pitch propeller blade root, also for helicopter rotor torsion hinge.*
6. *Helicopter tail rotor blade root bearing.*
7. *Light section bearing used for many applications including helicopter blade hinges.*

Timken bearings can be supplied to meet widely differing requirements, for example, the steep angle bearings 1, 2, 3, 5 and 6 are designed to meet thrust loads heavy in proportion to the radial loads. 4, resisting tilting, is chiefly subjected to radial loads, so is example 7. British Timken, Duston, Northampton, Division of The Timken Roller Bearing Company. Timken bearings manufactured in England, Australia, Brazil, Canada, France and U.S.A.

TIMKEN®

REGISTERED TRADE-MARK

tapered roller bearings

(*Continued from page 758*)

the engine historical record and a copy of the aircraft flight manual.

Boeing finally assures B.O.A.C. that the F.A.A. certificate will be provided, and signs the bill of sale. In exchange for the latter, B.O.A.C. hands over the outstanding amount due for the aeroplane, about one-third of the total having already been made in progress payments.

The aeroplane is now B.O.A.C.'s property, and a signal to this effect is dispatched to London immediately so that insurance cover can be obtained. About 24 hours is usually required from the completion of these formalities to departure from Seattle on the delivery flight. Customs clearance has to be obtained, and this includes clearance for the Rolls-Royce Conways and various items of British equipment imported free of tax, under special Act of Congress for re-export. The 707s are also imported into Britain free of tax.

Delivery Flights

Most of the delivery flights have been made from Seattle to London direct, with bare cabins, but on two occasions during the summer a full complement of seats was shipped out and the aircraft stopped at Montreal en route to pick up fare-paying passengers. Apart from the Microcell seats, the aircraft lack, on delivery, only certain items of the G.E.C. galley equipment, the Bendix engine vibration and temperature indicator, and the Marconi Doppler navigation equipment.

Flight planning for the delivery flights is done in the B.O.A.C. office in New York, which is better equipped to do this than Seattle. The procedure followed is exactly the same as for a regular commercial flight, using a Great Circle course unless more than 15 minutes can be saved by taking account of high favourable winds. Pressure-pattern flying is not practised as such, but tracks are chosen to obtain the best compromise between pressure patterns when sufficient time can be saved and if appropriate A.T.C. clearances can be obtained. The flight plan for the 13th delivery flight, on which we were one of the six passengers, was a typical one, following airways north-east to Carmi, in Canada, then going direct to Frobisher via Churchill and following the Great Circle course from Frobisher to London, coming into Airway Red 3 via Bush Mills.

The average tailwind component was only 24 knots—higher values can be obtained with luck—to give a flight-plan time of 8 hr. 42 min. for the 4,210 naut. miles. The fuel to destination worked out at 53,695 kg., to which was added 9,360 kg. diversion fuel (the diversion for London was Prestwick, with a flying time of 1 hr. 27 min.) and the minimum contingency reserve of 3,500 kg. (for 49 min. flying). The captain—who on this particular flight was Capt. Field—elected to add 4,445 kg. extra contingency reserve to give the aircraft full tanks—72,115 kg.—and a maximum endurance of 11 hr. 48 min. The aircraft's gross weight, at 130,428 kg. (296,000 lb.), was well inside the maximum permissible take-off weight of 311,000 lb.

Photograph copyright "The Aeroplane and Astronautics"

The flight deck scene as delivery flight JDF013 begins its decent over the Irish sea; Capt. H. J. Field is in command with F.O. John Lee in the right-hand seat.

B.O.A.C. 707 operations are normally conducted for minimum cost, at Mach 0.82. The operation is controlled on engine r.p.m., using 101.5% for take-off and 95% for the climb (this is pulled back to 93% for one minute at New York and London to reduce noise on the climb out). The initial cruising altitude is selected to give a Mach 0.81 cruise at the max. cruise r.p.m. of 93%, or less if the aircraft is at low weight. As fuel is burnt, the speed is allowed to increase to Mach 0.82, and is then brought back to 0.81 again by reducing r.p.m. An increase in altitude (which normally has to be a 4,000-ft. step) is not considered to be an advantage until Mach 0.82 is being obtained at 87% r.p.m. Maximum altitude used is 42,000 ft.

At the top of the descent, almost exactly eight hours out of Seattle, the estimated landing weight at London Airport was 77,500 kg.—233 kg. less than the figure calculated before take-off. Descending along Red 3, first Blackpool Tower and then the great dish of Jodrell Bank's radio telescope provided pin-point fixes, before we entered the cloud which—inevitably—blanketed London Airport. We broke cloud again directly over the river at Greenwich, and turned in past the Crystal Palace television mast to make a long, flat approach, coupled-up on the auto-pilot, to London's 28R runway. Eight hours and 55 minutes after leaving Seattle, another delivery flight had been completed and B.O.A.C. had its 13th Boeing 707.—F.G.S.

The Pattern of Skycoach

FOR a variety of reasons, operation of the new Skycoach low-fare services on certain cabotage routes from London to Central and East Africa, the Caribbean area and the Far East, introduced in October, has produced an extraordinary complexity of arrangements between the five operators concerned, only three of whom operate these services physically. The division of the services between the five airlines has been known for some time on paper (see our issue for Sept. 30, p. 468) but, as the table below shows, three of the five airlines are using aircraft of one or more other operators for some or all of their services.

In part, these arrangements have been dictated by the equipment available to the airlines—E.A.A. for instance, has no suitable aircraft for the Skycoach service. Although C.A.A. has Viscounts, it relinquished its traffic rights between the Federation and the U.K. to B.O.A.C. three years ago, in return for a sum of £1,750,000 payable over the 10 years to 1967.

From the table, and assuming present frequencies are maintained, it appears that the Skycoach services will actually be flown in the following yearly totals (a 48-week year has been assumed here to avoid fractions in the totals).

B.O.A.C. (in own right)	46
B.O.A.C. (on behalf of C.A.A.)	6
British United (in own right)	12
British United (for B.O.A.C.)	6
British United (for C.A.A.)	12
British United (for E.A.A.)	12
Cunard Eagle (in own right)	6

It was the fact that a majority of the B.U.A. services are being flown on behalf of other operators that led to the protest from BALPA, on which we commented in our Oct. 7 issue. Expanding on its earlier statement BALPA has pointed out that it is claiming "B.O.A.C. Britannia rates for B.U.A. Britannia pilots and B.E.A. Viscount rates for B.U.A. Viscount pilots. The comparable rates for the lowest grade of Senior Captain on a Britannia 300 series are: B.U.A. £2,370 and B.O.A.C. £3,539; and for the lowest grade of Captain on a Viscount 800 series two-crew aircraft, B.U.A. £2,115 and B.E.A. £2,840."

In addition to the Skycoach services, B.U.A. is flying two Viscount "Safari" services a week between London, Entebbe and Nairobi, and one service a week each on the routes to Ndola, Lusaka and Salisbury, and to Bathurst, Freetown and Accra. These are all-economy class at standard I.A.T.A. fares, which are now slightly lower than the old Colonial Coach class fares at which these services previously operated. The right to operate these services goes back to 1957, when the independents (Airwork and Hunting Clan) were promised a 30% share of the economy-class revenue on the routes to East and Central Africa. Whether the Skycoach traffic is now included in this 30/70 split between B.U.A. and B.O.A.C. has not been revealed.

Destination	Frequency	Scheduled by	Operated by
Aden (projected) ..	4 a year	B.O.A.C.	B.O.A.C. Britannia 102
Bermuda and Nassau ..	Bi-monthly	B.O.A.C.	B.O.A.C. Britannia 312
	Bi-monthly	Cunard Eagle	Cunard Eagle Britannia 318
Bridgetown and Port of Spain	Bi-monthly	B.O.A.C.	B.O.A.C. Britannia 312
Entebbe and Nairobi ..	Bi-monthly	B.O.A.C.	B.O.A.C. Britannia 102
	Bi-monthly	B.U.A.	B.U.A. Viscount 810
	Monthly	E.A.A.	B.U.A. Viscount 810
Montego Bay and Kingston	Bi-monthly	B.O.A.C.	B.O.A.C. Britannia 312
Ndola and Lusaka ..	Bi-monthly	B.O.A.C.	B.U.A. Viscount 810
	Bi-monthly	C.A.A.	B.U.A. Viscount 810
Ndola - Lusaka and Salisbury	Bi-monthly	C.A.A.	B.U.A. Viscount 810
	Bi-monthly	B.U.A.	B.U.A. Viscount 810
Salisbury	Bi-monthly	B.O.A.C.	B.O.A.C. Britannia 102
	Bi-monthly	C.A.A.	B.O.A.C. Britannia 102
Singapore and Hong Kong	Monthly	B.O.A.C.	B.O.A.C. Britannia 102

The Fighting Services

R.A.F. East Africa

GROUP CAPTAIN J. C. MACDONALD, C.B.E., D.F.C., A.F.C., has been appointed Senior R.A.F. Officer, East Africa, with the acting rank of Air Commodore. Until recently the United Kingdom National Military Representative at SHAPE, he takes up his post in Nairobi later this month.

From 1946 to 1948 Gp. Capt. Macdonald served in Germany in various appointments, including those of S.A.S.O., No. 2 Group, and O.C., No. 139 Wing at R.A.F. Wahn. He commanded Coningsby from September, 1948, until taking command of R.A.F. Khormaksar, Aden, in mid-1950. Later he served as Senior Air Officer at H.Q., British Forces, Aden.

Since returning to the United Kingdom in the autumn of 1951, Gp. Capt. Macdonald has served in the Directorate-General of Organization at the Air Ministry; as O.C., R.A.F. Flying College, Manby; and as station commander at R.A.F. Habbaniya, Iraq, and R.A.F. Akrotiri, Cyprus.

Bomber Command Electronics Award

A NEW trophy, known as the Rietzke Award, has been won for the first time by Sgt. J. H. O. Willacy at R.A.F. Cottesmore as the airman who has shown "the greatest promise in the field of electronics" at this Bomber Command station. More than 70 airmen at Cottesmore have taken a special course in electronics prepared by C.R.E.I. (London), the European Division of the Capitol Radio Engineering Institute, Washington, who have presented the trophy for annual award.

Named after the founder and president of C.R.E.I., Mr. E. H. Rietzke, the trophy is made in oxydized silver on bronze and represents the path of free electrons round the nucleus of a lithium atom. The electrons are in silver, suspended on wire in Service blue, and the atom itself is shown as a globe of the World.

In addition to Sgt. Willacy, runners-up for this year's award, Flt. Sgt. B. George and Cpl. Tech. J. Cumber, have received medallions.

Indian Air Force Developments

DURING the past 12 months a number of new projects and developments have been undertaken by the Indian Air Force.

In the operational field a new major formation, the Eastern Air Command, has been formed at Calcutta to meet the Service's growing responsibilities of air defence and for air support of the Army and civil power in that area. Two more squadrons of the Indian Auxiliary Air Force have also been established at Bhuvaneshwar and Chandigarh, and a jet flight has been added to the Delhi Squadron. At least four senior pilots of this squadron have completed their solo flying in Vampires.

The Air Force Flying College at Jodhpur and the two flying training wings at Hyderabad are training fighter, bomber and transport aircrew for the steadily expanding Service, while officer and other rank ground training is undertaken by two colleges and three schools. The Paratroopers Training School at Agra has had the distinction of training the first Indian woman paratrooper, Flt. Lt. Gita Chanda, an I.A.F. medical officer.

An aeronautical development centre and test laboratory has been established at the I.A.F. base at Kanpur where the Avro 748 is being built under licence. Another research laboratory has also been opened at Jodhpur.

In addition to its own personnel, the I.A.F. is training Indonesians for both air and ground duties, and Air Cdre. Kanwar Jaswant Singh has been detached to the Ghana Air Force. A number of I.A.F. flying instructors have also been loaned to the United Arab Republic Air Force.

Recognition Competition

ORGANIZED by the Aircraft Recognition Society, the 14th all-England aircraft recognition competition will be held at the Royal Aeronautical Society on Jne. 21, 1961. Entries must be received by the A.R.S. at 15 Tavistock Street, Covent Garden, W.C.2, by Dec. 21.

The competition is open to teams of three members representing various societies and Service units, including the Royal Observer Corps, Air Training Corps, and NATO powers. As in previous years, six trophies—the Silver Hurricane, the Bristol Britannia, the Silver Heracles, the *Air Pictorial*, the Bristol Bloodhound and the Royal Netherlands Fokker D.21 Trophies—for team and individual award will be contested.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. A. Fry, O.B.E., to the Department of the Chief of the Air Staff, with acting rank of Gp. Capt.; Wg. Cdr. R. C. Rylance to the Department of the Air Member for Personnel.

Fighter Command: Wg. Cdr. F. Rothwell, D.F.C., to R.A.F. Middleton St. George to command, with acting rank of Gp. Capt.

Coastal Command: Sqn. Ldr. F. A. Houghton, M.B.E., to R.A.F. St. Mawgan as Senior Technical Officer, with acting rank of Wg. Cdr.

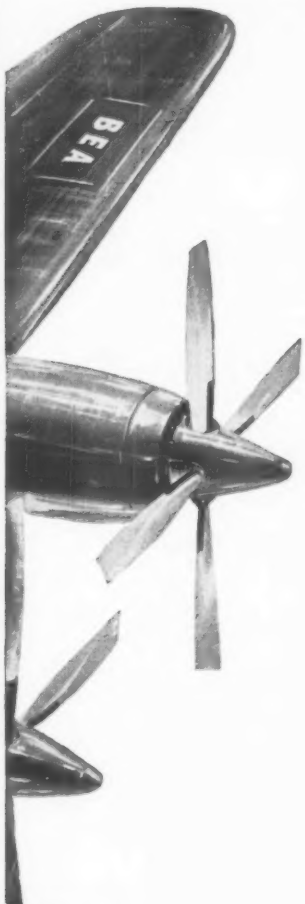
Flying Training Command: Gp. Capt. F. W. M. Jensen, O.B.E., D.F.C., A.F.C., to R.A.F. Ternhill to command.

Technical Training Command: Gp. Capt. R. E. Baxter, D.F.C., to R.A.F. Uxbridge to command; Gp. Capt. J. St. C. Polson to R.A.F. Henlow as Senior Medical Officer; Wg. Cdr. H. Clark to No. 3 Radio School, Compton Bassett, as training officer in charge of plans; Wg. Cdr. A. Ruda to Headquarters, No. 24 Group, for education duties.

Other Appointments: Gp. Capt. S. H. Bonser, M.B.E., to the British Defence Staff, Washington; Wg. Cdr. D. R. Levinson, B.E.M., to the Proof and Experimental Establishment, Pendine (War Office) as Deputy Superintendent.

AKROTIRI TOWER.—A Vulcan B.1 of No. 617 Squadron, piloted by the squadron commander, Wg. Cdr. L. G. A. Bastard, A.F.C., flying over the new air traffic control tower at R.A.F. Akrotiri, Cyprus. One of the original three Bomber Command Vulcan B.1 squadrons, No. 617 is expected to follow the lead of No. 83 Squadron and re-equip with Vulcan B.2s in the near future.

The longest queues are for the cheapest seats



People want to travel. They want to travel quickly. They want to travel cheaply.

Economy fares offered by airline operators have turned these requirements into record traffic figures. During 1959, 72% of all North Atlantic passengers flew 'Economy Class' and on U.S. domestic trunk lines Coach Class travel held a record share (43.6%) of the market. In Australia cheap fare travel has increased by 102%.

These results were obtained with existing aircraft. The Vickers Vanguard has been specifically designed to cater for mass air travel at low fares and presents airline operators with the finest opportunity of gaining an even more profitable share of this great expanding market.

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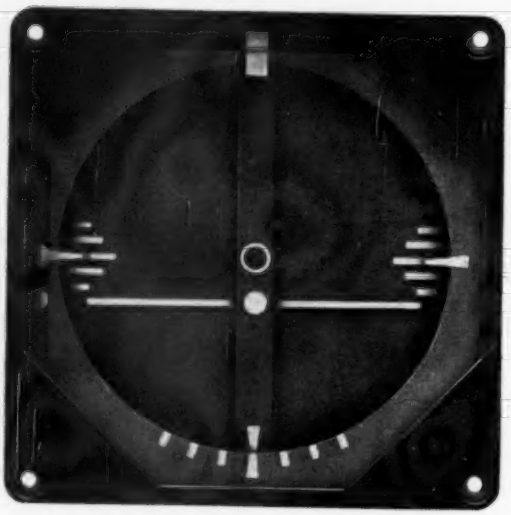

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Helicopter Instrument System

The Ferranti Helicopter Instrument System currently being developed comprises the panel mounted Director Horizon and Hover and Navigation Display together with their associated computers and dynamic references. The purpose of this system is three-fold:

- To provide the pilot with a means of monitoring the automatic systems.
- To enable the pilot to take over under directed manual control in the event of failure of either one or more of the automatic systems.
- To enable the pilot to learn and practice the art of advanced instrument flying.

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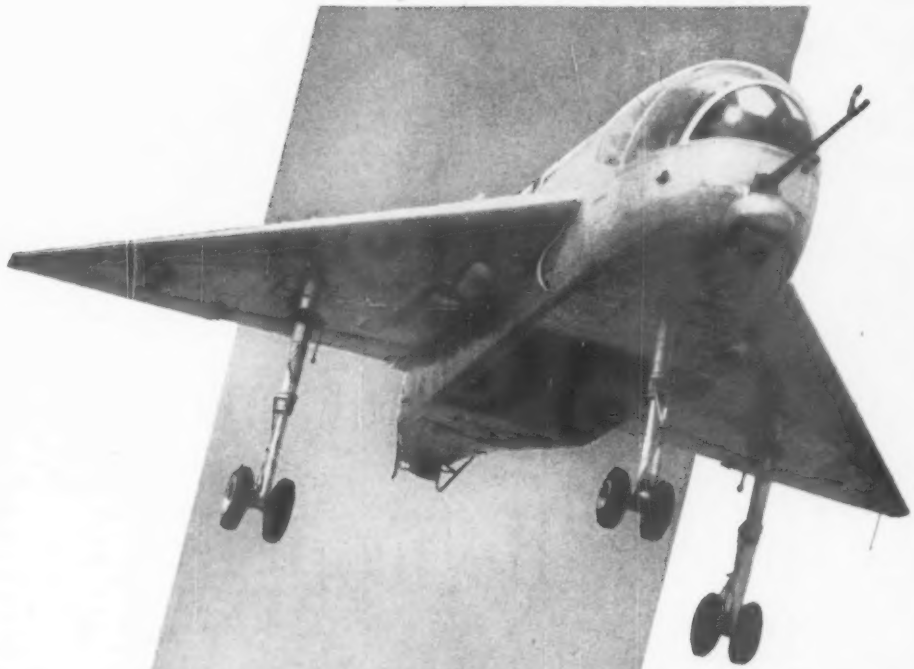

The *Short* SC.1 goes forward

The recent dramatically successful demonstrations on seven successive days at Farnborough by the Short SC.1 proved conclusively to the world that Shorts have achieved a major break-through in aeronautical progress. With smooth and effortless transition from jet-borne hovering to wing-borne flight and vice versa now a routine operation, the way to pure jet VTOL military and civil aircraft of the future can be clearly seen.

Developed by Shorts under a Ministry of Aviation research contract, the SC.1 has four Rolls-Royce RB.108 jet engines mounted vertically for lift, with a fifth at the tail for propulsion. A Short-designed auto-stabiliser system gives automatically controlled stability during hovering and transition. No other aircraft achieves VTOL in this way. No other aircraft has brought high performance VTOL to the stage of immediate application to aviation's everyday needs. And no other team has developed so much of the practical equipment which will be needed in the VTOL aircraft of tomorrow.

AT **Shorts** IDEAS TAKE SHAPE **on time**

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British Helicopters
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Recoverable Satellite Projects

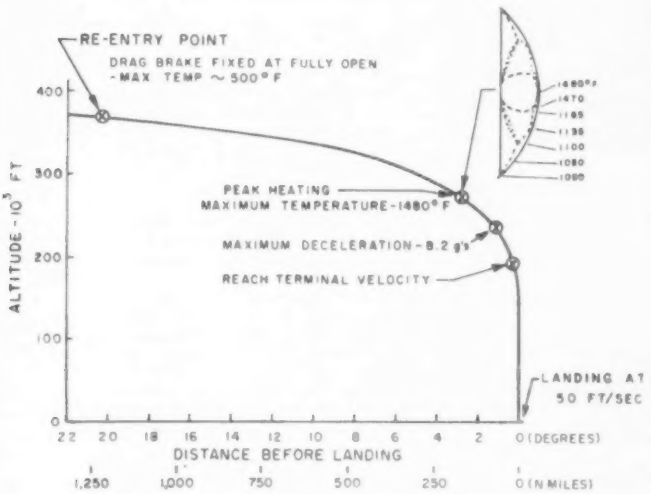
THREE companies have now been selected by the U.S.A.F. to develop the Samos E-6 reconnaissance satellite. They are the Martin Company's Baltimore Division, General Electric's Missile and Space Vehicle Department, and Eastman Kodak. Martin's rôle will be to mate the recoverable capsule, to be produced by General Electric, to the rocket booster. Kodak will supply the photo-intelligence equipment.

The present Samos E-5 system is based on a development of the Discoverer satellite programme, employing the Atlas-Agena vehicle. General Electric make the 300-lb. re-entry capsule. Recovery is effected by separating the capsule from the Agena satellite stage, after the satellite has been stabilized in a backward position 60° down from a horizontal plane. The capsule is then separated, spun-up by solid rockets, and pushed out of orbit by means of a retro-rocket. (THE AEROPLANE AND ASTRONAUTICS, Aug. 26, 1960, p. 235.)

Although few details of the E-6 project are available at present, it has been reported that the new recoverable satellite, weighing up to 3,000 lb., will include smaller capsules capable of being returned to Earth individually either by command or by means of pre-set programming. These smaller capsules are expected to have different weights and sizes permitting the inclusion of a wide range of reconnaissance equipment.

Another recoverable satellite system is being developed by the Avco-Everett Research Laboratory of Massachusetts. This is a space-capsule with a difference.

Instead of plunging back through the atmosphere like a ballistic nose-cone, it is designed to unfurl a large drag brake which lowers it to the ground through a far less rigorous "re-entry corridor." A few months ago, the U.S.A.F. awarded Avco an initial $967,000 contract to develop and flight-test recoverable satellites based on the company's original researches.

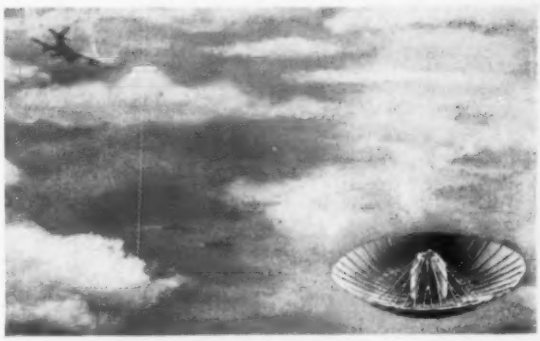


Estimate of the deceleration and heating conditions to which the Avco drag brake satellite would be subjected, according to a design study carried out at the Avco-Everett Research Laboratory between 1956-59.

Although little can be revealed of this project at the moment, it is known to follow similar lines to proposals made by Dr. A. R. Kantrowitz and his colleagues at the I.A.F. Congress, held in London in 1959. The re-entry vehicle—originally designed to be manned—takes the form of a pressurized capsule surrounded by a light-weight foldable structure, giving it the appearance of an inverted umbrella when the drag brake is fully spread.

Opening and closing of this structure in orbit results in a 20 : 1 drag variation, giving a corresponding change in the rate of descent or orbital lifetime. Controlled variation of the drag according to a pre-set programme will, the designers claim, permit landing to be made on sea or land with high accuracy.

The extended structure has a low wing-loading (only 1½ lb./sq. ft.) and consequently the vehicle decelerates high in the atmosphere, and radiates re-entry heat away at temperatures which never exceed present gas turbine practice. Terminal velocity is sufficiently low for parachutes to be dispensed with for final recovery.



Artist's impression of the Avco-Everett drag brake recoverable satellite which, in a modified form, has been the subject of a recent U.S.A.F. research and development contract.

According to the original paper, the drag brake skin would consist of stainless steel cloth made of 0.001-in. wire woven into a close, 400 by 400, mesh. Then a layer of thin 0.0005-in. stainless steel sheet cut into circumferentially aligned ribbons, would be added and finally another layer of cloth of coarser mesh.

The ribbons will eliminate porosity, yet are considered flexible enough to satisfy the folding requirements for packaging inside the nose-cone of the rocket launcher. The supporting ribs of the drag brake would comprise thin stainless-steel beams with reinforcing cap strips.

The manned recovery vehicle proposed in the I.A.F. paper had an orbital weight of only 1,527 lb., which is less than that of the Mercury ballistic capsule. If, as seems likely, the U.S.A.F. is supporting the Avco scheme as part of its reconnaissance satellite programme, it could well be that any development-capsule which results from present research activity will be made sufficiently large to permit manned re-entry experiments later in the programme. In this sense, it could be seen also as a back-up to the NASA Mercury project.—K.W.G.

Russia's Third Spaceship

A THIRD spacecraft, of large volume, was launched by the Russians on Dec. 1. It contained two dogs (Pohelka and Mushka), "other animals, insects and plants." The Tass announcement stated that the experimental animals were being studied by means of television and telemetering systems, which sent their information to ground-recording stations.

The launching follows two earlier experiments on May 14 and Aug. 19 respectively. In the first, a "dummy" astronaut

Designation	Launch date	Payload	Perigee	Apogee	Period	Orbit incl.
		lb.	miles	miles	min.	deg. to equator
Spacecraft I (Sputnik IV)	May 14, 1960 (6 p.m. EDT)	10,008 total; pressure cabin 5,512 lb., inst. 3,250 lb. (including dummy astronaut)	188.5 191*	228.7 429*	91.1 94.25*	64.9
Spacecraft II (Sputnik V)	Aug. 19, 1960 (Recovered Aug. 20)	10,134 total, incl. pressure cabin, in two dogs, rats, mice, plants, etc.	190	211	90.72	64.57
Spacecraft III (Sputnik VI)	Dec. 1, 1960	10,221 total, incl. pressure cabin, inst., two dogs, etc.	117	165	88.6	65 (approx.)

Comparison of payloads and orbital characteristics of the three Soviet spacecraft. * Orbital elements after firing retro-rockets on Spacecraft II on May 19, 1960. This vehicle—in separated condition—is still in orbit.

was the occupant of a two-part spacecraft. Although the pressure cabin apparently separated in orbit, a fault in the orientation system sent the two components into a higher orbit instead of initiating re-entry.

The second firing—involving two dogs (Strelka and Belka)—was entirely successful, recovery of the pressurized capsule and the spacecraft itself being achieved during the satellite's 18th orbit of the Earth. The dogs were said to have landed in the U.S.S.R. within 6½ miles of the designated point. Details of this pioneer experiment were fully outlined in THE AEROPLANE AND ASTRONAUTICS on Aug. 26, 1960, p. 234; Sept. 16, p. 396, and Sept. 23, p. 438.

The main difference between the latest experiment and the earlier ones was the orbital height. The first Soviet spaceship had a perigee of 188.5 miles and an apogee of 228.7 miles; comparable figures for the second were 190 and 211 miles. The third spaceship, however, was lowest of all with a perigee of 117 miles and an apogee of 165 miles. These and other orbital parameters, and payload weights, are compared in the table.

Communication Satellite Proposals

ANOTHER meeting of the All-Party Space Research Committee, sponsored by the British Interplanetary Society, was held in the House of Commons on Dec. 1. On this occasion the subject under discussion was Communication Satellites.

Talks were given by a number of industrial representatives some of whom have been engaged in actual study-projects for British communication satellites. Speakers included Mr. G. K. C. Pardoe (de Havilland Aircraft Co.); Dr. W. F. Hilton (Hawker Siddeley Aviation); Mr. J. R. Brinkley (Pye Telecommunications, Ltd.); Mr. A. H. Cooper (F.M.I.); Gp. Capt. E. Fennessy (Decca Radar); and Dr. L. R. Shepherd, the former B.I.S. President.

The meeting was informed of a feasibility study by de Havilland which would involve a network of eight active relay satellites to provide continuous global coverage for radio communications. The satellites would be linked with 24 ground stations distributed throughout the Commonwealth. To make a telephone call, say between London and Sydney, the London transmitter would beam the signal to the nearest satellite which would retransmit the signal to the next ground station, and so on, until it had been received by the ground station in Sydney.

Each of the proposed satellites would weigh between 400 and 700 lb. and would be well within the payload capacity of the proposed Blue Streak/Black Knight combination.

De Havilland estimate that on the basis of a British launcher the system could be established for a total cost of £70 million over 20 years. Calculations were made on the basis of each satellite launched costing £1 million, and each ground station approximately the same. This includes a reasonable sum for contingencies, such as launching failures and satellites which fail in orbit or come to the end of their operating life. A further sum of about £173 million would be required for the maintenance of ground stations.

Problems of Spacecraft Shielding

TWO heavy bands of radiation, called the Van Allen belts, girdle the Earth. Beyond them are the so-called "galactic cosmic rays" and the solar flares, intermittent bursts of radiant energy from the surface of the Sun. All these forms of radiation offer a potential hazard to man when his spacecraft loses the protection of the Earth's own natural radiation shield—the atmosphere.

To meet this problem, the Aero-Space Division of Boeing Airplane Company has begun a series of extensive studies into the nature of space radiation and ways and means of minimizing its effects on the spacecraft and its human crew. First results indicate that the vehicle's structure, propellent, water and food supplies offer the most promising shielding materials. Dense metals such as lead make the most efficient shields but they are much too heavy for comprehensive protection.

A big problem in this respect is that of estimating precisely the amount of shielding needed without adding unduly to the spacecraft's weight. To this end, Boeing physicists are working on a more precise method of calculation using mathematical models in which all the variables of the shielding problem are expressed in terms appropriate to computing machines.

Explosions on the Sun—solar flares—are at present the most unpredictable source of space radiation. In an effort to find a solution, the Boeing research team is collecting a mass of information on solar flares in the hope of proving statistically that the flares occur either under certain conditions or within certain time intervals, or both. If the likely onset of a solar flare can be predicted in advance, spaceflights can be planned accordingly.

Boeing point out that avoidance of the dangerous radiation may provide a solution to at least one aspect of the problem. A spacecraft leaving the Earth, for example, might take a path from either the North or South Pole where it would avoid largely both Van Allen belts.

Of more direct methods, Dr. Arnold A. Hicks, team-leader of the Physics Technology Department, has said that "exotic metals" might play an important part in spacecraft shielding. Boeing have been examining zirconium hydride and lithium hydride as possible materials.

Even "electronic" radiation shields have not been overlooked despite their affinity with the ideas of science-fiction. Boeing say their studies include "the use of an electro-static field generator to repel electrons.

"The invisible radiation shield, a negatively charged electric current, would repel other negatively charged particles such as electrons. A spacecraft equipped with such a shielding device would be protected from electrons by 'blowing' them out of its path."

This, the company suggests, could afford protection for manned Earth-satellites orbiting in the vicinity of the outer Van Allen radiation belt. There is, however, no mention of the power requirements for operating a shield of this kind, or of the weight it would entail in relation to more conventional shielding methods.

The company's final approach has been to consider ways of increasing the resistance of spacecraft and human systems to radiation damage. While part of the research team is investigating methods of improving the resistance of electronic equipment, the space-medical section is studying the use of drugs, such as cysteiamine, which they believe may raise man's radiation resistance by 50%.

Euro-space Co-operation

IF European countries are to launch artificial satellites, will they use a launching vehicle built in Europe or one produced in the United States? This was a major talking point among the 11 nations which met in Geneva last week (Nov. 28-Dec. 1) to consider the first steps in setting up a European Space Research Organization. Nations represented were Belgium, Britain, Denmark, France, West Germany, the Netherlands, Norway, Sweden, Italy and Switzerland. Spain, which began as an observer, was elected to full membership at the end of the four-day meeting.

Delegates of the respective nations agreed to set up a commission to look into the problems of setting-up the co-operative organization, in particular, its structure and financing. It will meet again in Paris within a month of the ratification of the agreement by member countries.

Previous meetings of scientists interested in establishing a European Space Research Organization have taken place in London and Paris during the past year at which various matters related to upper air and space research were discussed. At the last meeting in London, recommendations were made for consideration by the Governments of the 10 countries concerned. One, for example, was for the sharing of payload space in sounding rockets and the standardization of certain equipment, such as stabilized nose-cones.

The Geneva meeting, however, was the first occasion that Governments have been officially represented. The British delegation was headed by Mr. R. N. Quirk, an under-secretary to the Minister of Science; with him were representatives of the Treasury, the Foreign Office, and the Ministry of Aviation.

The proposed European consortium will, it appears, be concerned only with the design of sounding rocket equipment and artificial satellites; it will not be involved in the development of launching vehicles. Dutch representatives and others in Geneva wanted to include launching vehicles within the terms of reference of the organization from the start but this was strongly resisted, especially by the British delegation.

It was clear that the British were not empowered to offer Blue Streak for use as a space-launcher and this must have been a big factor in restricting the activities to the design of space-payloads. The discussions which Mr. Peter Thorneycroft, the Minister of Aviation, has had with Australian, Canadian and French Governments, it was emphasized, were a separate issue which had still to be resolved.

Should agreement be reached to establish the European Space Research Organization, it appears that the new group could turn to any nation or group of nations engaged in the production of launching vehicles to put their equipment into orbit. Whether this is going to be done by the Americans, ourselves with the help of France and other nations, or even by the Russians, has still to be worked out.

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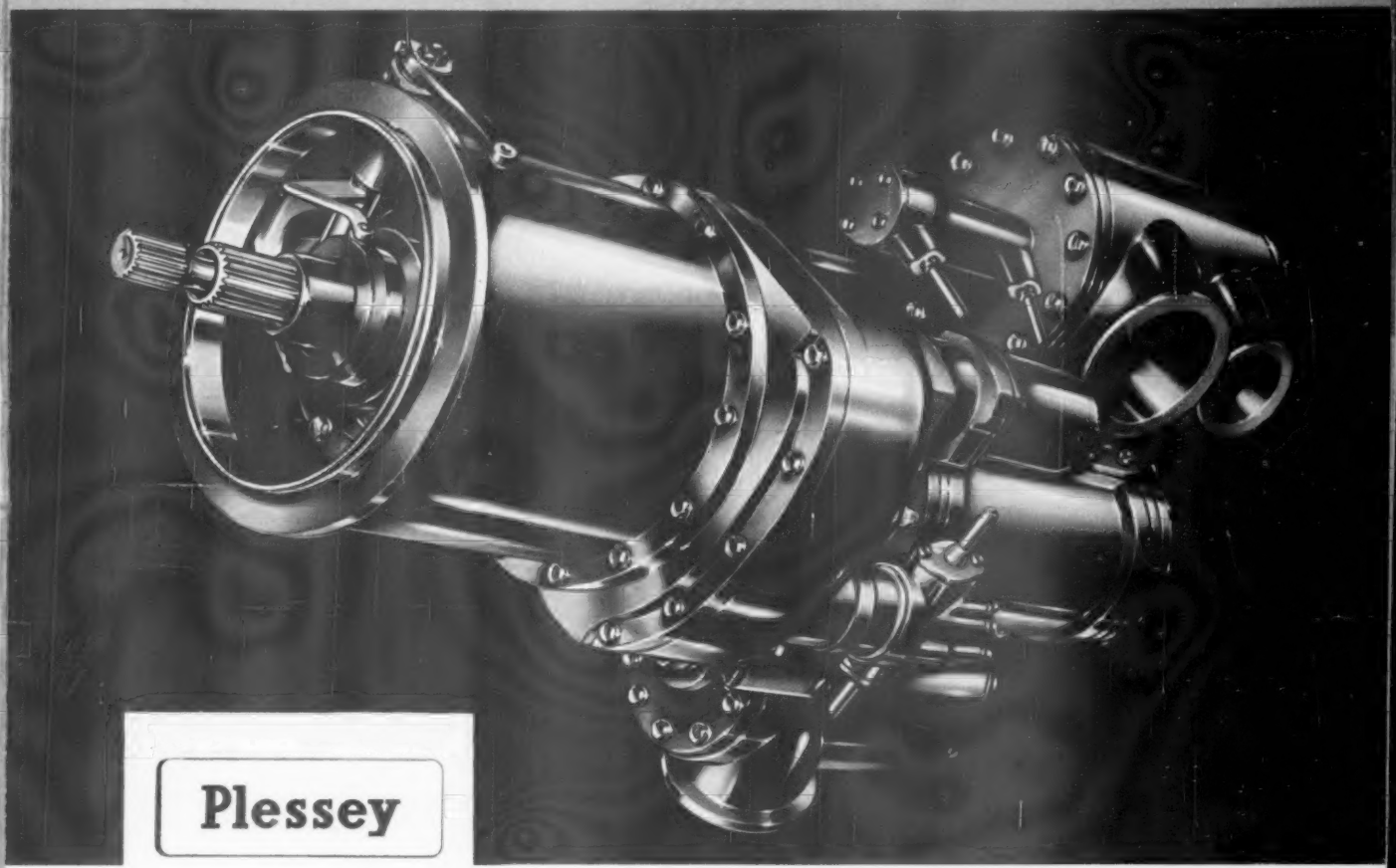

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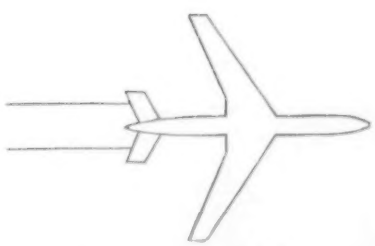

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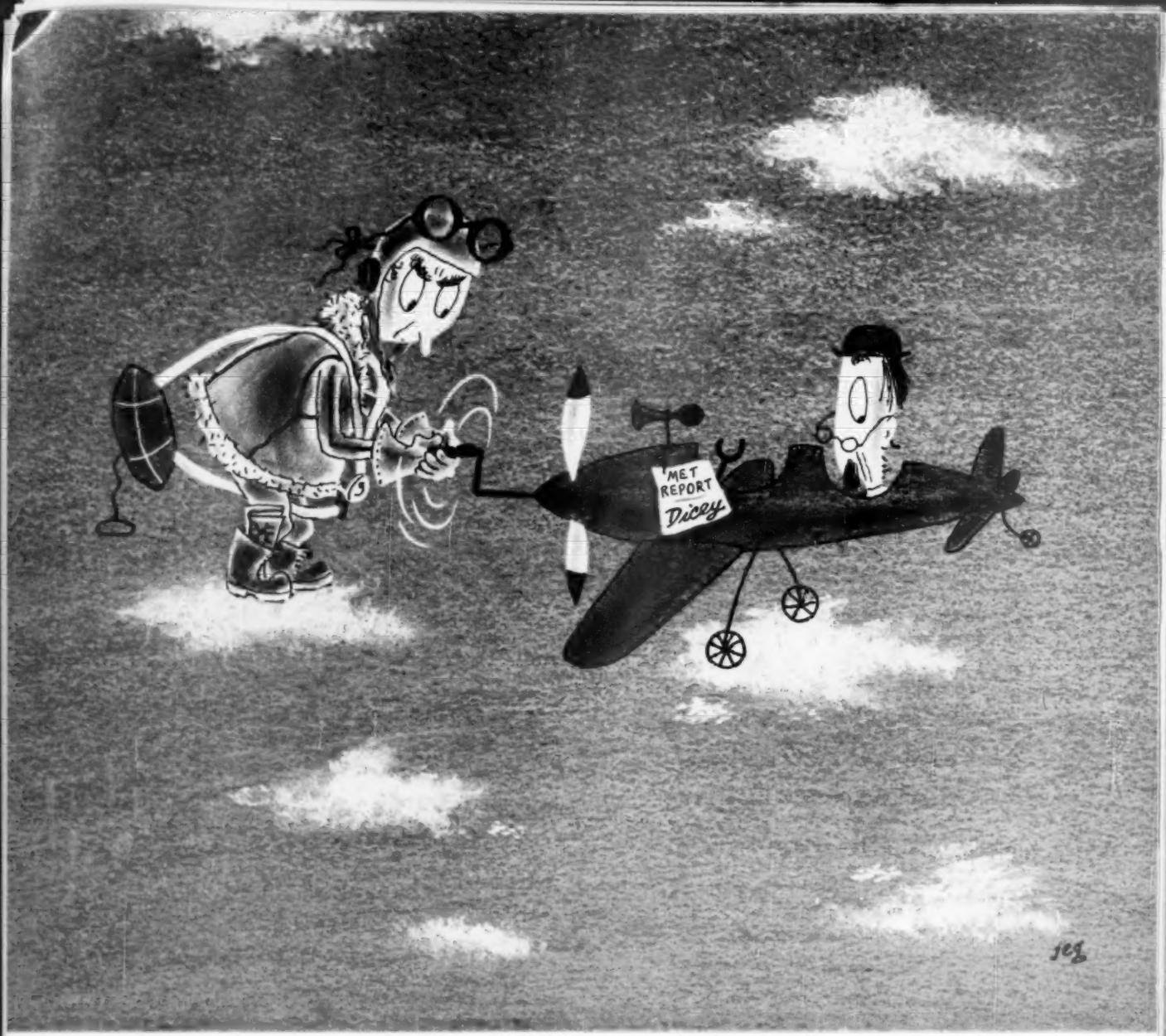

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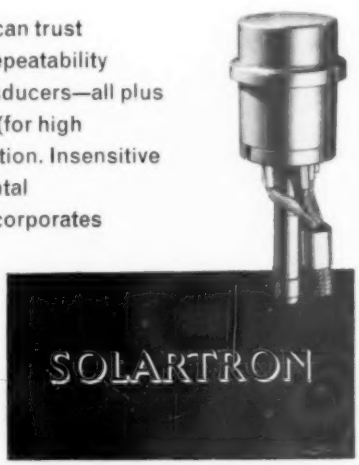

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International VTOL Survey

The Supersonic VTOL Transport Reconsidered*

Our annual survey of developments in VTOL and rotary-wing craft throughout the World is given in the following 19 pages. Among the features are a review of Britain's hovercraft industry and a technical study of the new Hawker VTOL fighter.

THE initial conception of jet lift as proposed by Dr. Griffith, of Rolls-Royce, had clearly in view the development of a supersonic transport aircraft of which the aerodynamic configuration and propulsion system would be highly refined and designed specifically for the cruise condition. Such an aircraft would be quite incapable of operating from normal runways and would require some other means of take-off and landing. This would be provided by special lightweight lifting engines, thus enabling the highly sophisticated aircraft to take-off and land without aerodynamic compromise and also giving the undoubted advantages of being able to take-off and land with zero forward speed and in any conceivable weather conditions with far-reaching effects on safety and regularity.

This proposal was made about the time work started on the Short S.C.1 Jet Lift Research Aircraft and it certainly had some influence on the philosophy inasmuch as the research aircraft was designed not only to explore the aerodynamic feasibility of VTOL but also as the first stage in the development of an engineering system for future operational aircraft which would depend entirely on lifting engines and their control systems, and would never need to use a conventional runway.

Concurrently with the design of the S.C.1, a number of initial project studies in the field of supersonic jet lift transports were carried out at Shorts. These were based on the Rolls-Royce R.B.108 lift engine used in S.C.1 and so far as possible on practical design techniques. The initial reaction from these project studies was that the supersonic VTOL transport was impossible. First, the performance required could not be achieved with a reasonable size of aircraft; the savings in structure weight and improvements in cruise efficiency were not

* By F. P. Youens, project engineer, S.C.1. Short Bros. and Harland.

International VTOL Survey . . . .

sufficient to offset the weight of the lifting power plant and VTOL control system. The account would not balance. Secondly, the number of lift engines required ran into hundreds; this was quite appalling, as the practicability of starting even four engines simultaneously in the air in S.C.1 had yet to be proved. In consequence, little further work was done on the supersonic transport; it was not written off, but the project effort was directed towards shorter-term applications of jet lift.

In the meantime S.C.1 design and development continued. As was to be expected with such a radically new aircraft, this was not without its problems, particularly in view of the associated engineering development with new engines, new controls and complete dependence on electro-hydraulic stabilization and control transmission. These problems have in the main been solved, or at least practical solutions can be foreseen, and the practicability of the S.C.1 type of aircraft demonstrated.

One is nevertheless conscious that operational experience on the type is nil and operational development is yet to be done. It is also clear that more engineering development is required before an operational aircraft can be put into service, but the stage has been reached at which much of this would be direct development of the aerodynamic and engineering devices on S.C.1 and no basically new approach is necessary. It is, in fact, development in reliability and performance that is needed.

Significant changes have also taken place on the lifting power plant. The recently disclosed lifting engines of sixteen to one thrust-weight ratio roughly halve the lift engine weight. This factor, added to the installational improvements which six years of work on jet lift have shown to be possible, means that the account of structure and fuel weight-saving and jet lift penalty is now much nearer to a balance.

The lighter lift engines result in a reduction in weight of the aircraft and this, coupled with the use of engines of greater individual thrust than the R.B. 108, brings the number of engines required to a much more reasonable figure. The installation and operation of the required number of lifting engines is still a major engineering problem, but with the background of successful experience on S.C.1 its eventual practicability is no longer in doubt.

The time is obviously ripe for a reassessment of the supersonic VTOL transport aircraft: let us examine the position. The VTOL supersonic transport is "on" if two conditions can be satisfied; first, it must be a practical proposition and must not entail engineering or operational development of a different order from that of a conventional supersonic transport and, secondly, it must be an economic proposition. For a proper quantitative assessment of these two factors a carefully conducted study is needed bearing S.C.1 experience in mind and comparable with that being undertaken for the conventional supersonic transport aircraft. In this article it is only possible to deal qualitatively with the subject, and in these terms it would seem that there are some significant pointers:—

1. The S.C.1 system works and the aerodynamic and engineering principles of control and stabilisation during the transition can be applied to the supersonic VTOL transport.
2. The development of VTOL is the development of a flight regime; it replaces the development required for satisfactory qualities for conventional take-off and landing, which, for the highly refined configuration envisaged for the supersonic transport, will not be negligible.
3. At first sight the development problems in supersonic flight appear to be the same for both aircraft. Further examination is required, however, before this can be accepted: reliance on jet lift for take-off and landing reduces the necessity to compromise the planform and propulsion system for low speed flight and may thus make the high speed problems more tractable.

These factors, and indeed the whole discussion, have so far been concerned with the development of the aeroplane. It is necessary also to consider the operational development of this new type of aircraft. So far as the technical problems of operating bases are concerned sufficient experience is available to reveal the important factors and no undue difficulty should arise here. Other operational aspects, however, such as noise, navigation and approach aids, and other special "user" problems would also need to be studied. It is probable that the operating technique can only really be worked out with an actual aircraft; indeed, an operational training period usually precedes the introduction of a new type into airline service. In the case of the VTOL transport some of the differences are quite radical and there would be advantage in carrying out at least some of the operational development at an early stage on the first VTOL aircraft of comparable type which is available.

What, then, is the general conclusion? In the writer's view we can fairly say that such an aircraft has now left the realm of speculation and can be considered an engineering possibility, albeit still an engineering task of the first magnitude. This change has taken place in six years since work first started on the S.C.1. It would be short sighted to suppose that the point has been reached at which no further improvements can be expected. If the present rapid rate of technical progress is sustained, which in view of the newness of the field it could be, we may, in another six years, agree with Dr. Griffith that the VTOL supersonic transport is not only possible but is the most economic.

MULTI-ENGINE TRANSPORT HELICOPTERS (see opposite page)

	VERTOL 107–II†	SIKORSKY S.61L	WESTLAND 192C*	WESTLAND ROTODYNE	WESTLAND WESSEX 2	S.A. FRELON
DIMENSIONS						
Rotor diameter (each) (ft. in.)	50 0	62 0	48 11	109 0	56 0‡	49 2‡
Gross disc area (each) (sq. ft.)	1,995	3,019	1,880	9,340	2,460	1,894
Overall length (ex. rotor) (ft. in.)	44 7	54 9	57 2	69 5	65 10	48 10‡
Overall height (ft. in.)	16 10	15 4	17 4	27 3	15 11	15 5
Internal cabin dimensions (ex. flight deck):						
Length (ft. in.)	24 2	31 11	24 0	52 9	15 6	22 11‡
Max. width (in.)	79	78	68‡	116.5	60	74.75
Max. height (in.)	72	75.5	74‡	84	70	72
Floor area (sq. ft.)	145	—	—	480	—	139
Usable volume (cu. ft.)	860	1,040	720	3,360	—	—
Volume of baggage hold (cu. ft.)	—	59	100	—	—	—
ACCOMMODATION						
Maximum (seats at in. pitch)	25	28 at 34	23	70 at 32	12	28
Typical (seats at in. pitch)	—	—	—	57 at 34	—	—
WEIGHTS (for 100 ft./min. climb, s.l., with one engine inoperative)*						
Operating weight empty (lb.)	10,425	9,270	12,332	—	8,126	11,220
Max. internal fuel (lb.)	—	2,835	4,800	10,250	2,400	5,300
Max. payload (lb.)	8,000	8,900	7,007	17,500	5,374	4,400
Max. take-off weight (lb.)	18,450	18,700	19,000	58,500	13,500	16,520
Max. landing weight (lb.)	18,450	18,700	19,000	58,500	13,500	16,520
Disc loading (max. t.-o. wt.) (lb./sq. ft.)	4.62	6.2	5.05	6.26	6.4	8.72
Power loading (lb./h.p.)	8.02	7.05	5.78	—	5.5	8.7
PERFORMANCE (I.S.A., sea level)						
Best econ. cruising speed (knots/ft./lb.)	135/1,000/–	118/0/17,500	120/2,000/19,000	200/5,000/–	100/0/13,500	113/0/16,520
at power, h.p., with consumption, Imp. gal./hr.	—	1,400/142	1,960/187	—	–/103	1,780/162
Initial climb, vertical (ft./min.)	1,240	600	450	2,150	450	120
Initial climb, inclined (ft./min.)	1,700	1,600	1,000	—	1,500	1,100
Best climb with one engine out (ft./min.)	—	300	500§	—	940	300
Hovering ceiling, out of ground effect (ft.)	—	5,000	5,500	9,000	10,000	2,760
Hovering ceiling, in ground effect (ft.)	7,800	7,000	9,000	—	13,000	6,240
Service ceiling (ft.)	13,700	9,500	13,500	—	17,500	10,500
Range (no reserves) with max. fuel (naut. mi.)	250	270	400	575	300	482
at knots at ft. with lb. payload	–/0/6,000	118/0/–	120/2,000/2,000	—	100/0/2,974	113/0/0
Range (no reserves) with max. payload (naut. mi.)	40	—	40	—	—	77.5
at knots at ft.	—	—	120/2,000	—	—	113/0
POWER PLANT						
No. and type	Two CT58–110	Two CT58–110	Two Gazelle 2	Two Tyne	Two Gnome H.1200	Three Turmo IIIB
Max. t.-o. power (h.p./r.p.m.)	1,250/19,500	1,250/19,500	—	—	1,050/–	820/34,000
Max. contingency rating (h.p./r.p.m.)	—	1,250/19,500	1,650/–	—	1,350/–	—
Intermediate contingency rating (h.p./r.p.m.)	—	—	1,465/–	—	—	—
Max. continuous rating (h.p./r.p.m.)	1,050/19,500	1,050/19,500	1,210/–	—	—	720/33,200

* Westland 192C data are based on a 320 ft./min. climb with one engine inoperative and the other on intermediate contingency power at sea level. † Brochure data, not necessarily uniform with remainder of tabulation. ‡ Unfurnished. § Using max. contingency power.

Helicopters for the Commercial Operator

ACCORDING to the current edition of the *ABC World Airways Guide*, 10 airlines now operate scheduled passenger services with helicopters, including some of a seasonal nature. The past year or so has seen the inauguration of service by five of these 10 operators, whose activities are therefore necessarily still in a formative stage. The bulk of helicopter operating experience still rests with the three American "giants"—New York Airways, Chicago Helicopter Airways, and Los Angeles Airways; with Sabena in Europe and possibly with Russia's Aeroflot, which is expanding its helicopter services at a vigorous rate.

To these names can be added that of British European Airways, one of the earliest of all helicopter operators, with a substantial background of experience but no current regular operations. The newer operators are Air Florida Helicopter Airways and Sea-Tac Airways, both flying Alouette IIs and operating local services respectively around Tampa, Florida, and Seattle and Tacoma, Washington; and three in Italy—Alisud, Elivie and C.I.E., using Agusta-Bell 47Js to serve Naples, Capri, Ischia, Salerno, Rimini and San Marino. Other airlines planning helicopter operations include Ansett-A.N.A. in Australia and Fuji Air Transport in Japan.

The shortness of this list is evidence enough that the helicopter is still very far from being a satisfactory commercial vehicle, since there is no doubt that the ability to operate from small, confined areas is, in itself, a worthwhile goal for any airline. In 1959, the three major U.S. helicopter airlines carried a total of 366,315 passengers on 139,380 flights—an increase of nearly 500% in three years, and indicative of public acceptance of this type of service. The barrier to full exploitation of helicopter transportation continues to be the lack of a suitable aircraft. All scheduled helicopter operations to date (with the possible exception of a few in Russia) have been by single-engined machines carrying not more than 15 passengers and sometimes as few as two. Hopes of a "vertical transportation breakthrough" now rest, therefore, on the next generation of helicopters—multi-engined, turbine-powered—to be available from 1961 onwards.

There is reason to believe that among the types now becoming available, airlines will find helicopters which will make break-even scheduled operation possible. They will be the basis for the next round of development, with the emphasis upon improving the still-marginal single-engined performance and introducing suitable instrumentation and radio aids for all-weather operation in minima comparable with those applied today to fixed-wing aircraft.

Tabulated data on the opposite page were supplied by the makers in response to requests from THE AEROPLANE AND ASTRONAUTICS, and so far as possible are reduced to a common basis. The status of the various current transport helicopter projects is briefly discussed below.

Boeing Vertol 107-II. New York Airways has ordered 10 of these tandem-rotor helicopters to replace its fleet of piston-engined Vertol 44s, and a Japanese operator, Fuji Air Transport Co., Ltd., plans to use two. Developed from a transport helicopter designed for the U.S. Army (the YHC-1A), the 107-II promises to be the first multi-turbine helicopter in airline service, with deliveries starting in April next year, and is the type with which New York Airways hopes to become free of subsidy by 1966. For certification testing, a YHC-1A has been converted to 107-II standard and began flying on Oct. 24.

The Vertol 107-II rotor and transmission systems have been designed to accommodate powers up to 2,300 s.h.p. The ultimate engine envisaged for this model is the 1,250 h.p. General Electric CT58-110, derated to 1,150 h.p. for take-off; the 1,050 h.p. CT58-100 will be used at first. Features of the 107-II are its airline-type interior with few c.g. restrictions, and a preloaded baggage container fitting into the rear fuselage in the position occupied by the loading ramp on the military model. The hull is watertight and the stabilizing pontoons for water operations also serve as fuel tanks.

Sikorsky S-61L. Competing strongly with the Vertol 107-II, the Sikorsky S-61 has been ordered by Los Angeles Airways (5) and Chicago Helicopter Airways (6); Ansett-A.N.A. is reported to have paid a deposit as evidence of serious interest in the S-61. It also is derived from a Service model—the U.S. Navy HSS-2—and, as a result, has behind it a massive test and development programme, in addition to Sikorsky's long experience of single-rotor designs. First delivery was originally scheduled before the end of this year, but as the prototype civil S-61 has yet to fly, this date was clearly over-optimistic. Both L.A.A. and C.H.A. hope to be operating S-61s before the end of 1961 however.

A complete description of the S-61 was published in THE AEROPLANE AND ASTRONAUTICS for Jan. 8, 1960. This helicopter also is intended to be powered by two 1,250 h.p. CT58-110 engines, but will probably use the lower-powered CT58-100s at first. Interior layouts for up to 28 passengers have been planned, and in all cases provide for a 100-cu.-ft. baggage compartment forward of the cabin. Amphibious capability is available for those airlines which require it.

Sikorsky Projects. Of possible interest to commercial operators eventually will be the range of Skycranes now under development. Derived from the S-60 prototype already flown, these are designed to handle bulk loads externally; one such load demonstrated on the S-60 is a "people pod" for 20 passengers which, by being independent of the main structure, is remarkably vibration-free.

Next to fly, about a year from now, will be the S-64, powered by two P. & W. JFTD-12 turbines and able to carry a 9-ton payload. This will be dimensionally similar to the S-60, with a rotor diameter of 72 ft. Largest flying crane so far envisaged by Sikorsky would have a 160-ft. rotor, a gross weight of 230,000 lb. and a 40-ton payload, with four JFTD-12 turbines.

Sikorsky also have been studying a compound helicopter similar in concept and appearance to the Westland Rotodyne. Powered by two General Electric T64s, this has a gross weight of 39,000 lb., an 8,000-lb. payload and an economical cruising speed of 200 knots at 10,000 ft.

Westland 192C. This is the civil version of the Bristol 192 Belvedere, deliveries of which to the R.A.F. began a short time ago. Backed by an extensive programme of development and production, the 192C is one of the most advanced tandem-rotor helicopters available in the next two years, although it suffers from a rather small fuselage cross-section.

B.E.A. has been evaluating the Vertol 107-II, Sikorsky S-61 and the 192C, and is now understood to be close to purchasing the British type for interim use on domestic services. Initially the Corporation wants two helicopters of about this size, and will use them between Land's End and the Scilly Isles; later, up to eight more might be purchased. The operation would be subsidized by the M.o.A., which makes an annual grant towards the cost of the Helicopter Experimental Unit.

Westland 194. Brief details have been published of this further development of the Bristol tandem-rotor theme, in which an auxiliary fixed wing is used to off-load the rotor, providing about 50% of the total lift at cruising speed. The rotors still provide the major part of the propulsion, supplemented by the residual jet thrust from four de Havilland Gnome H.1200 shaft turbines. Seating up to 50 passengers, the 194 has two 55-ft.-diameter, six-blade rotors, a 40-ft. wing span and a 77-ft. fuselage length. It could be available as soon as, or before, the Rotodyne.

Westland Rotodyne. Both B.E.A. and New York Airways have been negotiating orders for the Rotodyne, of six and 15 respectively, and the M.o.A. has agreed to provide B.E.A. with a £1,400,000 subsidy over five years to help pay the costs of introducing the Rotodyne into service. Progress with the enlarged, Tyne-engined version has, however, been slow and the president of N.Y.A. recently expressed concern at the lack of production.

Like the other types described above, the Rotodyne is expected to benefit from Service interest, and an R.A.F. order for an initial batch is being negotiated. Development of the design in the Fairey Division offices at Hayes has recently increased the size of the production version still further, as the tabulated data shows, and maximum seating capacity is now given as 70.

Westland Wessex 2. Expected to fly next year, the Wessex 2 is a variant of the Wessex 1 (Sikorsky S-58 developed), now in production for the Royal Navy. With two de Havilland Gnome turbines, it will have good single-engined performance and will be able to carry realistic payloads in high temperatures and at high altitudes. It may be of interest to airline operators as a taxi rather than a major transportation vehicle.

Sud-Aviation SE 3200 Frelon. Development of the Frelon as France's largest helicopter provides a possible basis for the eventual production of an airline helicopter, although the Frelon itself is a military type. Airline versions for up to 24 passengers have been studied, and data are included in the tabulation opposite for comparative purposes.

Agusta AZ-101G. Another military development, the AZ-101G is under construction by Italy's foremost helicopter company and, like the Frelon, may provide a basis for the development of a commercial version in due course.

International VTOL Survey . . . .

The World's First VTOL Strike Aircraft

A FORTNIGHT ago we published two uncommonly revealing photographs of the Hawker P.1127 V/STOL strike fighter after the aircraft had completed its hovering trials. Based on a study of these photographs and information given about the P.1127's powerplant, a fairly detailed assessment can be made of this important new aircraft.

First, however, the most important point to note is that the P.1127 is not a research aircraft. Far from it; it has been designed from the start as an operational aircraft, initially as a Hawker private venture and later under Ministry of Aviation contract. Mr. Thorneycroft, the Minister of Aviation, has said that it was designed "to meet a probable military requirement" and that Britain is exploring the possibility of NATO adopting the aircraft.

As the photographs show, the aircraft is relatively small and almost definitely subsonic. It has been designed around the novel Bristol Siddeley BS.53 lift/thrust engine, a front-fan turbofan. Its fan and turbine exhaust flows are divided and lead to two pairs of nozzles. These can be revolved to direct the flow aft to give thrust, downwards to give lift or to intermediate positions to give combinations of lift and thrust.

Dr. S. G. Hooker, technical director (aero) of Bristol Siddeley, has given the thrust of the BS.53 as 15,000 lb. and its thrust/weight ratio as 7 : 1. An s.f.c. of about 0.6 lb./lb./hr. was quoted for a civil version of the engine. These figures probably apply to production engines; it is usual for prototype engines to deliver less thrust.

Differences between the two official photographs tend to confirm this; the ground view was apparently taken when the aircraft was rolled out and shows it with undercarriage doors in position. These and its pitot tube are absent in the view of the aircraft hovering, and may have been removed to reduce weight.

Assuming that the engine thrust is 15,000 lb., the P.1127 must weigh less than this when fully loaded if it is to take-off vertically. But it could make a short-distance take-off at a higher weight. In fact, today, the feeling is growing that true vertical take-off will rarely be needed and STOL operation—when defined as reaching a height of 50 ft. in a distance of 500 ft.—is a more realistic requirement. In practice there is little difference in the thrust needed for short take-off of this type and for vertical take-off.

With an all-up weight of under 15,000 lb., the P.1127 is closer to the weight class of the Fiat G.91 than to the Hunter FGA.9, which goes up to 24,000 lb. The P.1127 has obviously been designed with extreme economy of weight in mind at every stage.

The Hawker team has probably aimed to produce a successor to the R.A.F.'s ground-attack Hunter, the FGA.9 and, NATO's ground-attack aircraft, the Fiat G.91. As such the P.1127 will probably deliver any of the weapons carried by these aircraft and, in addition, have all-weather performance as specified for new NATO aircraft.

Nothing official has been released about performance, but the built-in thrust of the P.1127 must ensure a high cruising speed at low level—probably around Mach 0.9—and a very high rate of climb. The aircraft has doubtless been designed for two types of mission, low level all the way to the target in one case and, for greater range, ascent to a moderately high level, followed by descent to low level to deliver an attack. At sea level the radius of action of the Fiat G.91 is 150 n.m., and it is reasonable to suppose that Hawkers chose a similar or greater radius when deciding the P.1127 specification.

The Aircraft in Detail

As already mentioned, the photographs of the P.1127 show a relatively small aircraft; its length, 41 ft. 2 in., is 5 ft. less than that of the Hunter FR.10 and its wingspan, 24 ft. 4 in., is more than 9 ft. less. The aircraft's short-span wing has a swept leading-edge and marked anhedral. Its fin and rudder are of typical Hawker shape, reminiscent of those of the Hunter, and it has a tailplane which is apparently all-moving. The three-view drawing on page 367 is based on the official photographs.

The cockpit is right at the nose of the fuselage and, as the hovering photograph shows, the pilot has an excellent view both ahead and to the sides, essential for VTOL operation.

Just behind the cockpit are the two massive intakes for the powerplant. They are much larger intakes than normal because the BS.53 inhales much greater quantities of air than would a pure turbojet of the same thrust; and it exhausts this air at lower velocity.

In the photographs the intake is seen to have a large and bulbous lip, doubtless to ensure efficient intake flow during hovering and very slow forward flight. Such an intake lip would be a considerable drawback at high speeds. It could well be inflatable, so that at high speeds it could be deflated to give an intake lip of conventional radius.

These intakes lead air direct to the Bristol Siddeley BS.53 turbofan which must fill most of the volume of the centre fuselage. Above the engine is mounted the wing; it may be of one-piece construction in the interests of lightness and could be lifted from the fuselage as a single unit to allow engine removal. The lift/thrust nozzles of the BS.53 are beneath the wing, the front pair just below the leading-edge and the rear pair below the trailing-edge.

SUBTLE LAYOUT.—First published in our issue of Nov. 25, this P.1127 photograph shows the engine jet nozzles, here in the lift-thrust position; the engine air intake with its bulbous lip, which is apparently inflatable; the marked anhedral of the wing; and the bicycle undercarriage with wheel-door airbrake.

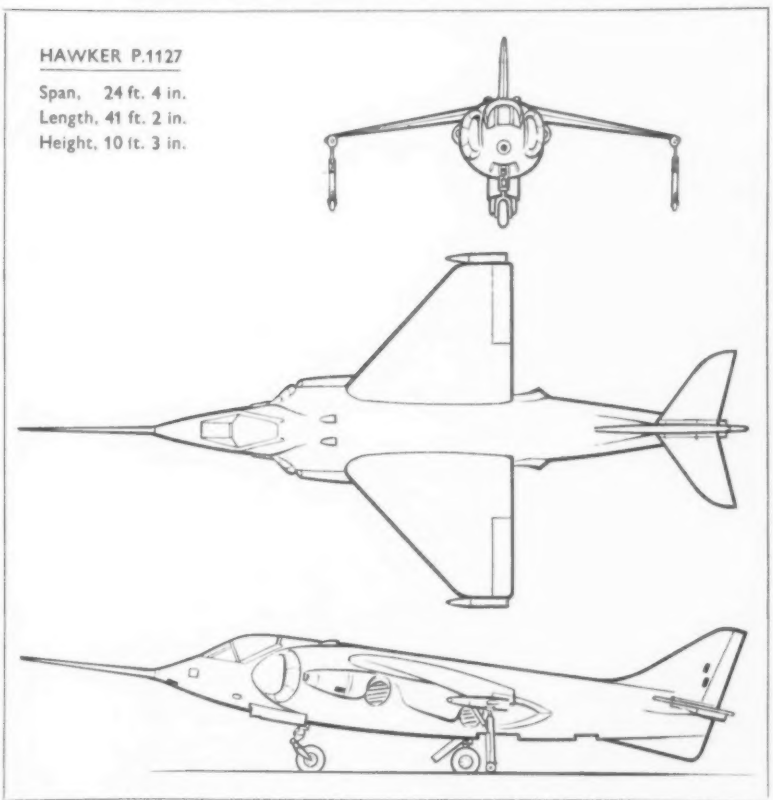
The aircraft has a bicycle-type undercarriage, with most of the load being taken on the twin wheels of the rear unit, which retracts backwards. It has a single-piece undercarriage door in front of the wheels; this can probably be lowered either partially or fully to act as an airbrake.

The steerable single-wheel nose undercarriage retracts forwards. Both main undercarriage units have large-diameter tyres, and tyre pressure is probably very low by modern standards to allow the P.1127 to operate from unprepared surfaces.

Outrigger struts at each wing-tip carry small wheels to steady the aircraft when it is on the ground. In flight they obviously fold back to extend horizontally behind the wing-tips as extensions of the bullet fairings at these points.

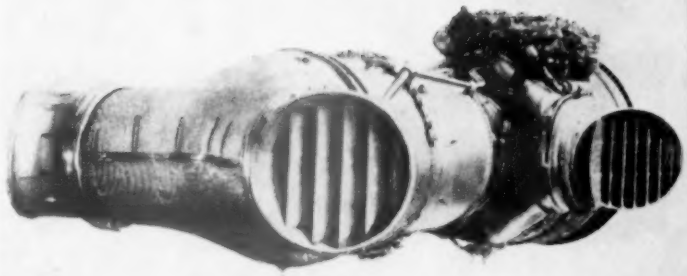
There appears to be no space in the fuselage for internal stowage of armament, and this is probably slung beneath the wing, in typical Hunter fashion. Two small bulges can be seen beneath the wing in the photograph of the P.1127 hovering; these may well cover attachments for underwing tanks, bombs or weapon pods.

Fuel is possibly carried in the relatively thin wing, but there are also undoubtedly fuselage tanks. There may be room for tanks behind the pilot between the intake ducts and in the fuselage behind the engine. There must be a considerable volume in the rear fuselage which could be used for the stowage of equipment, but the volume available for fuel is probably limited by C.G. considerations. For ferrying or extended-range missions, underwing tanks will probably be carried and these would give the aircraft a considerable range if it took off from a conventional runway.



Viewed as a whole, the P.1127 has evidently been designed as the smallest and cheapest aircraft for the task in hand. Considerable ingenuity has obviously gone into the design following the decision to rely on a single engine of novel type to give both lift and thrust and every effort has clearly been taken to produce the lightest structure.

The use of lift thrust, of course, helps a great deal as it allows aerofoil surfaces to be designed primarily for cruise conditions, with little of the compromise normally necessary to give an adequate low-speed performance. Thus the wing loading can be kept high, to meet the needs of high-speed cruise at low level, and also to give a low structure weight. This has probably been assisted by one-piece construction and anhedral, which combines to reduce the length of the fuselage outriggers and, incidentally, to combat any tendency to Dutch-roll.



LIFT AND THRUST.—Key to the performance of the P.112/ is its Bristol Siddeley BS.53 engine, with exhaust nozzles which revolve to give jet lift, propulsive thrust or combinations of both.

Other features which must have helped to reduce structure weight are the relatively short undercarriage and the simplification made possible because flaps are not needed and by using the rear undercarriage door as an airbrake.

Operation

Pitch, yaw and roll of the P.1127 during hovering and slow-speed flight is apparently controlled by puff pipes. Close examination of photographs shows that these nozzles are beneath the wing near the tips, under the fuselage nose and at the tail ahead of the ventral fin. They are doubtless supplied with compressed air bled from the BS.53 compressor.

For a short take-off the aircraft could be accelerated with the BS.53 nozzles giving horizontal thrust; at an appropriate speed they could rapidly be lowered to give lift thrust for take-off. For vertical take-off they can be directed downwards to give lift thrust and then gradually raised to accelerate the aircraft, finally reaching the horizontal when all the lift is aerodynamic.

These techniques, and safety considerations, suggest that the jet-nozzle mechanism allows the nozzles to be lowered very rapidly, but only to be raised slowly to prevent jet lift being suddenly removed, with possible catastrophic results.

During hovering the throttle of the BS.53 acts as an acceleration control rather than a velocity one. For this reason a very sensitive throttle control is probably necessary. For the same reason it would be very useful if the pilot had a very accurate indication of rate of ascent and descent during the hover.

Progress

Development of the P.1127 has been very rapid; the first drawings were issued to the Hawker experimental shop only in May last year. Its tethered hovering flights began late in October and both these and its free hovering trials were completed within a month.

It will now go to Bedford for its first flights as a conventional aircraft and then return to Dunsfold for the transition trials. If its rapid progress is maintained, it could well be making full transitional flights before midsummer next year.

The P.1127 represents an impressive achievement as the World's first military operational VTOL aircraft. It relies on the deflected-jet principle, but Hawkers would not claim that this technique is the only answer for VTOL aircraft. The Rolls-Royce technique using independent jet-lift engines has its own fields of application.

The argument for the BS.53 and the P.1127 is that they form the best combination for a simple, relatively small and cheap VTOL strike aircraft with the minimum of supply and maintenance problems in the field. Supersonic VTOL demands much larger, more intricate and expensive aircraft. At present the subsonic P.1127 represents a logical advance over the Hunter FGA.9 and the Fiat G.91—and it exists here and now.

J. R. COWNIE.

International VTOL Survey . . . .

Britain's Hovercraft Industry

DURING the past two or three years there has been a mushroom growth of popular and technological interest in the development of air-cushion-riding vehicles, and all over the World projects of one sort or another are to be found. Many of these are serious studies by serious teams; but a lot of them are little more than spectacular dreams which scarcely warrant more than passing attention. All have received a full measure of publicity.

It is interesting to recall that a year ago in the corresponding issue of THE AEROPLANE AND ASTRONAUTICS to this present one, it was possible to include a fairly comprehensive survey of American efforts in this particular field. Even then the amount of activity that one could record was quite extensive; doubtless much more effort in America and elsewhere has since been added. It might be said, in fact, that every permutation and combination of ways and means of achieving and applying an air cushion as a method of vehicle sustentation is probably being investigated somewhere.

There is, incidentally, much to suggest that to produce some form of air-cushion vehicle is a comparatively simple matter. Equally there is a good deal of evidence which indicates that there are likely to be a great many problems to be overcome and "unknowns" to be resolved, before such craft can become an accepted form of commercial transport.

When one ponders on the possibilities offered by such vehicles it is no wonder that they have caught the public imagination and have received so much attention in the popular Press. Equally, of course, the more one ponders, the more the counter-arguments begin to appear and the more circumscribed become the areas and duties for which the cushion-riding type of craft would seem suitable. Indeed, as has so often been the case with many a good technological advance, the first flush of enthusiasm can later become something of an embarrassment.

This has certainly been so with the helicopter which in the early post-war years was "oversold" by its protagonists as a divine gift—aeronautically speaking—to travelling humanity. In the event, it was subsequently learned that rotary-wing craft were but complementary to other less inspired forms of aircraft; that its realm of usefulness, although itself greatly important, was much narrower than that prophesied; that the rate of technical progress could not be hurried; and that the imponderable "operator-acceptance" factor was—for various reasons—rather more restrictive than at first thought to be the case.

By the very nature of things it can be taken as quite certain that this will similarly turn out to be the case with air-cushion craft—if it is imagined that their widespread acceptance and operation is "just around the corner."

That is not to say that the air-cushion-riding vehicle is not a remarkable device with a potentially great future. Quite rightly a great deal of effort and thought is currently being devoted to its development in various forms. But all this is in the very earliest of stages—advanced beyond, perhaps, the initial experimentation phases, but still very much in the "suck-it-and-see" era.

Nevertheless, it would be misleading to be over cautious in an approach to the development problems of air-cushion craft by trying to draw too many parallels with aeronautical engineering. Their development time-scale cannot be regarded as entirely comparable with that of aircraft; for example, a major setback is not likely to have such far-reaching consequences. Mistakes—even serious ones—made through ignorance or inexperience—at an "altitude" of a few inches are not likely to be disastrous. And, furthermore, much cruder methods can be used to assess basic changes in full-scale tests.

We in this country can claim a major measure of responsibility for the successful practical application of the cushion-riding vehicle. The principle of the air-bearing—which, after all, is the basis of this sort of craft—is not new *per se*. Nor is the idea of applying this principle, through the medium of a low-pressure plenum chamber to a form of vehicle, of particularly recent origin. However, it was not until Mr. C. S. Cockerell, an electronics engineer, devised the annular air curtain type of system, in which the air cushion supporting the craft is contained within a peripheral ring of higher-pressure air, that real progress began to be made.

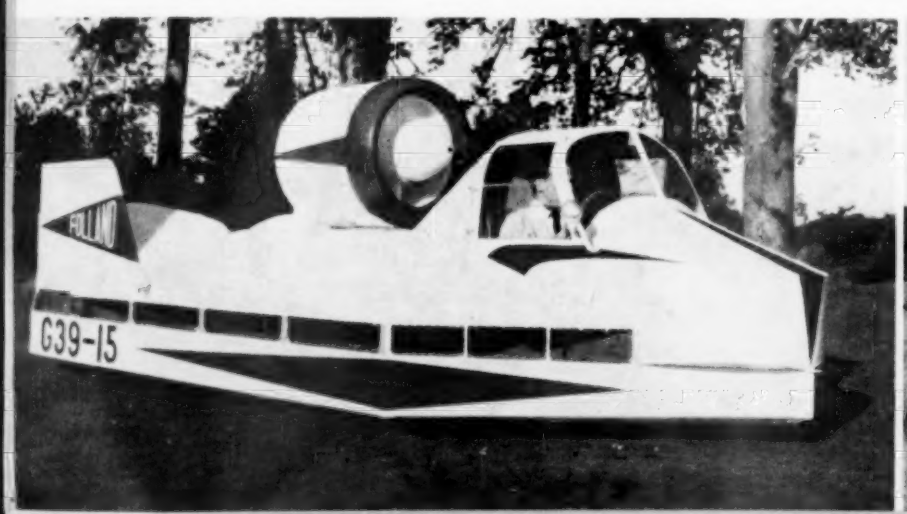
In Mr. Cockerell's invention, it is the force which is needed to deflect this air curtain outwards—so that at the surface it is ejected away from the centre of the vehicle—that determines the overall cushion pressure that can be sustained and the "lift" that can be generated. The main difference between Cockerell's system and the earlier, and cruder, plenum chamber type is that, in effect, the pressure cushion that carries the vehicle is made a part of it and any losses that may be used by leakage under the curtain will be made good by the curtain jet.

As is now well known, having propounded these ideas in 1953, Mr. Cockerell sought official support for them and in 1956 succeeded in gaining the interest of the Aircraft Research Branch of the Ministry of Supply. The effect of this was two-fold—first his ideas were given the distinction of being classified as "secret"; and in 1957 the Ministry awarded a contract to Saunders-Roe, Ltd., for the preparation of a detailed appraisal of the whole proposition concerning what Mr. Cockerell called "Hovercraft."

This investigation indicated that while such a craft had immense potential as a passenger and/or freight carrier, it would need a great deal of development. So in 1958, the National Research and Development Corporation was approached to see whether it would lend financial support to the project which, meanwhile, had lost its "secret" classification.

The Corporation decided in favour of Mr. Cockerell's ideas and following its custom formed a small subsidiary company—Hovercraft Development, Ltd. The board of this company comprises Mr. D. Hennessey (the Corporation's deputy managing director) as chairman; Mr. Cockerell; Mr. L. A. Sweny (seconded from Marconi's aeronautical division), and Mr. H. K. Turner (also from N.R.D.C.) as secretary.

Hovercraft Development, Ltd.—or H.D.L. as it is more familiarly known—was intended to control the project generally and to organize development work to the point where the existing industry could take over. To this end Saunders-Roe, Ltd., was given a further contract covering the design and manufacture of a full-scale manned research craft on the lines proposed by Mr. Cockerell. This machine, which took less than eight months to complete, was designated the SR-N1 and was first shown in public on Jne. 11, 1959.



It is not proposed to discuss in detail here, this first Saunders-Roe/Cockerell Hovercraft—it was described in full in our issue for Sept. 4, 1959. Suffice it to say, for completeness of this particular survey, that this prototype is oval in planform and measures 30 ft. long by 24 ft. wide. At its centre is a vertical intake duct in which is mounted a horizontal, helicopter-type Alvis Leonides radial engine developing 450 b.h.p. and driving a four-bladed fan. Forward of the powerplant and its duct is a control cabin with accommodation for a crew of two.

The efflux from the lift fan emerges underneath the craft from two narrow peripheral outlet ducts which form the air curtain enclosing the low-pressure air cushion for sustentation of the vehicle. These ducts are so arranged that the curtain jets are directed inwards at about 30° towards the centre of the craft to prevent leakage of cushion air when it is rolling or pitching.

It had originally been proposed to use a single curtain jet. Experiments made after construction had begun, however, tended to show that the stability of the craft would be inadequate with such an arrangement and that some form of division of the cushion into "compartments" would be necessary. One way of doing this would be to have transverse, or even longitudinal, jets in addition to the main peripheral ring, but this was reckoned to be too complicated to incorporate at the stage then reached.

The chosen solution, therefore, was to increase the planform area of the craft and to have a second peripheral jet outside the first. For this the outer curtain jet was located about 3 ft. from the inner one.

For forward propulsion, fore and aft side ducts are supplied with air bled off the main fan duct. Butterfly valves in the lift ducts provide pitch and roll control by permitting air to be cut off from sections of the peripheral curtain jets. Elevons at the extremities of the propulsion ducts were originally incorporated to supplement this control but subsequent tests showed that they were relatively ineffective and they were later removed.

As the machine had, from the outset, been intended principally for over-water operation, the earliest "flights" were made from the slipway at the company's Cowes works. These showed that the principle was sound enough but that the amount of water that was transformed into spray, which almost completely enveloped the craft when it was moving at low speeds, was something of a problem.

Soon afterwards, in an attempt to mitigate this, a bow section was added. This certainly improved matters and although the generation of spray is still something of a feature of the Hovercraft in this particular form, it diminishes with speed and at high operational speeds is reasonably acceptable.

Enjoying the distinction of being the first British Hovercraft, the Saunders-Roe/Cockerell SR-N1, which first "flew" in June, 1959, was fitted with a Marboré turbojet in March/April of this year to increase its speed. In May it was demonstrated on the Thames.

The following month, an ambitious public demonstration of the SR-N1's capability was arranged in the form of a crossing of the Channel from Calais to Dover. This was accomplished on Jly. 25, 1959. In September of last year, too, the machine was put through its paces at the S.B.A.C. Display during the course of which it lifted 20 fully equipped Royal Marines and carried them down the Farnborough runway.

By the end of 1959 the craft had completed no less than 100 hr. of "flying" time. It had, however, become clear that as it stood there was insufficient thrust available to propel it at speeds much in excess of 25 knots. As the hump speed was of the order of 12 knots and as normal wind speeds off Cowes during tests were nearly always about 12-15 knots, it was rarely possible to assess the craft above its hump speed.

In point of fact, because of the experimental nature of this first Hovercraft, no special attention had been paid to the design of low-loss ducting for the lift and propulsion systems. As a result, although the propulsion system as designed absorbed about one-third of the available engine power it gave only the equivalent of 25 b.h.p. at top speed.

Thus it was decided to add more forward thrust so that higher speeds could be attained. The easiest way of doing this was the addition of a separate forward propulsion powerplant —and an 800-lb.s.t. Marboré turbojet was installed aft of the cabin. For this a rearward facing intake equipped with a water separator was necessary in order to avoid the ingestion of large quantities of sea water spray. With the Marboré added, the SR-N1 was found capable of achieving speeds of 40-50 knots.

Up to the time the Marboré was installed, in March/April of this year, a total of 127 hr. had been "flown" and since then some 70 hr. have been added. Notable demonstrations, this year, have been on the Thames in front of the House of Commons in May and at Chatham to the Army in June. Although its original weight was 7,500 lb. it has in recent months regularly flown at 12,000 lb. all-up weight and even, occasionally at 18,000 lb.

There can be little doubt that despite the relatively crude

Latest of Britain's cushion-riding craft, the Folland GERM (extreme left) is intended for research only and is powered by two motorcycle engines. The Britten-Norman Cushioncraft (left), seen here in its original form without a tail fin, made its début in June this year at Bembridge.

International VTOL Survey . . . .

nature of the experiment, the SR-N1 has proved to be a most important source of practical information from which some invaluable lessons have been learned. Certainly, it showed to the World that Mr. Cockerell's ideas were sound and that a practical vehicle on these lines could be designed for operation over land and water.

It is not altogether surprising, then, that with this stimulus and lead an active and competitive "hovercraft industry" has come into being in Great Britain. This has Hovercraft Development, Ltd., as a central source of official encouragement in the form of financial aid, inspiration and information. H.D.L. holds the basic Hovercraft patents and has a technical group and research unit—until recently at Osborne on the Isle of Wight and now at Hythe—under the control of Mr. Cockerell.

In addition to these central facilities, the industry has five design and manufacturing components. Four of these—Saunders-Roe, Folland Aircraft, Vickers-Armstrongs (South Marston) and William Denny and Brothers—are working in close association with H.D.L. The arrangements with these companies are such that their activities in the air-cushion craft business are supported financially—to a fairly sizeable degree—by H.D.L. which also provides them with technical assistance and information as required. In return, H.D.L. is kept informed of the results of the development work in which it has a stake and, of course, will receive royalty payments on craft produced.

Although there is no direct or overriding control of the industry by H.D.L. in these matters, this particular form of arrangement does provide a useful means of ensuring that there is no unnecessary duplication of research and development work. In fact, it would appear that all four companies are working on different applications of the basic Hovercraft principle so that their projects are technically complementary even if they may be commercially competitive.

It is for this last-named reason as much as for the fact that it is early days yet in their design and development effort, that little information is available about the current work being done by the four companies concerned. There is also an understandable reluctance to say too much about the projects that are being considered for production.

Rather as one would expect, Saunders-Roe, with work on a second-generation Hovercraft already in being, has been the more forthcoming in this respect. But even so, few "hard facts" have been disclosed regarding the team's next project.

This craft—designated SR-N2 is a 27-ton passenger or car ferry for overwater operation with a maximum payload of 14 tons and a cruising speed of around 70 knots. Two main ducted fans provide the air curtain jets and two pylon-mounted propellers supply the thrust for forward propulsion.

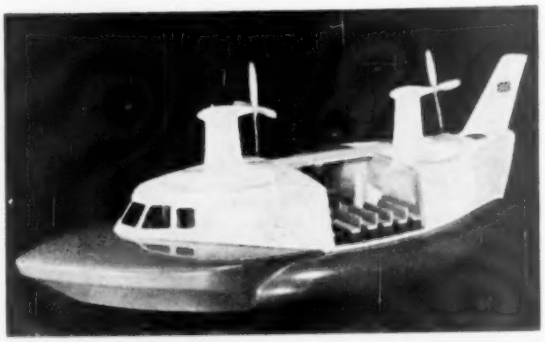
Shaft power for the fans and propellers is supplied by four 750-s.h.p. Blackburn A.129 free-turbine engines located in an engine compartment to the rear of the craft. The forward-thrust propellers can be rotated about their vertical axes to provide side thrust for directional control. Accommodation can be provided for 66 passengers in the central cabin which measures 20 ft. by 16 ft.

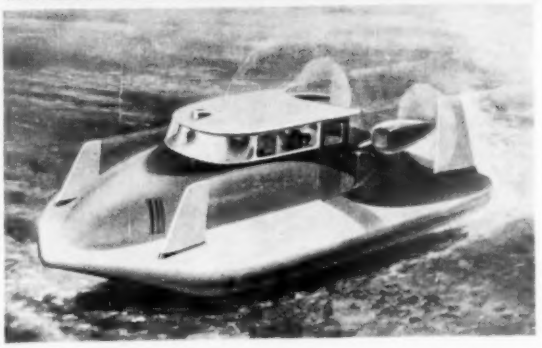
Although the SR-N2 is a fairly logical step forward from the SR-N1, it must still be regarded as an experimental craft intended for operational research. For example, its lift-fan, transmission, and control systems are very different to those of its predecessor. This new craft has, in fact, been designed to enable operators to obtain practical experience with air-cushion craft "in the field." It is reckoned to be capable of "stretch" to become a 40-ton 100-passenger craft.

Overall length of the SR-N2 is 63 ft. and its beam is 29 ft. 6 in. Normal internal tankage of 850 gal. gives it a maximum range of 200 nautical miles at an estimated direct operating cost of 4.5 pence per passenger-mile. Hover height at cruising conditions is 12-18 in. and at a light weight, 30 in. Specially designed for water operation the craft has a boat-like bow and can achieve 10 knots as a displacement vessel.

At the end of last year, Mr. M. J. Brennan, who had been chief designer at Saunders-Roe during the design and early development phases of the SR-N1, joined Folland Aircraft as chief engineer. And soon afterwards, not unexpectedly, it became known that the Hawker Siddeley Group—of which the Folland company is a member—had become interested in cushion-riding craft and that there was some active work in progress at Hamble to this end.

Few details of this work have come to light but it has recently been disclosed that the initial studies have culminated in a ground effect research machine (known as the GERM) for the practical full-scale investigation of the principles and characteristics established by the team's preliminary work. A photograph of this craft has now been published and shows it





Top, a model of the 27-ton Saunders-Roe SR-N2 project, powered by four Blackburn A.129 shaft-power turbines. Above, an artist's impression of the Vickers-Armstrongs 7½-ton project.

to be a very neat little craft with cabin accommodation for two.

The powerplant for the Folland GERM comprises two 700 c.c. Royal Enfield twin-cylinder motorcycle engines located at the rear of the vehicle. One of these drives the lift fan and the other drives a ducted fan mounted on top of the craft behind the cabin to give thrust for forward propulsion. Presumably this fan can be swivelled to give directional control.

Along the side of the vehicle, above what must be the displacement hull and curtain jet ducting are grille intakes, for the lift fan and powerplant. It is unlikely that a single large fan would be used for the lift curtain and one would expect that within the body of the craft are a pair of tandem ducted fans.

According to Hawker Siddeley, research craft of this type are "capable of being modified without any major structural changes to incorporate representative side-wall designs, recirculation systems and more advanced methods of control as required. They may also be used for on-the-spot investigations into operating problems in various parts of the World."

The first Folland GERM is at a comparatively early stage of its development at the present time but from it should come a great deal of useful information upon which to base future production-type craft. It is, in fact, part of a research programme which, it is hoped, will lead to the production of the "Hovertruck"—a utility vehicle mostly for over-land operation with a speed of 30 m.p.h. and carrying loads of up to 5 tons.

Vickers-Armstrongs (South Marston), Ltd., also has a team working energetically on the problems of air-cushion craft. Again, no details of the work at present being done have been given, but it is known that a small, relatively simple, vehicle for full-scale research has been built and is in the early stages of evaluation; it has, in fact, been reported that tethered hovering tests are in progress. As in the case of other companies, the object of the exercise at this stage is primarily to prove the system that has been proposed after initial investigation, and to provide data for the design of more ambitious production-type projects in due course.

Two such projects have, in fact, been disclosed by Vickers-Armstrongs. The first is a craft weighing 16,500 lb. and probably powered by three Blackburn Turmo turbine engines to cruise at 60 knots at a hover height of 12 in. Its normal payload would be 3,000 lb. and its range 120 nautical miles.

Overall length of this craft has been given as 49 ft. 9 in. and its beam as 20 ft. 1 in.; forward propulsion would be by two propellers at the rear of the craft. No details of its sustentation systems have been disclosed, although mention has been made of "an improved air jet system."

The company is at pains to emphasize that even this craft

is intended initially as a research and trials vehicle to give first-hand information on the handling and stability characteristics of the larger type of craft. It should also provide operational and performance studies to be made in realistic conditions.

The second Vickers-Armstrongs project, of which mention has been made, is a much larger craft with accommodation for up to 200 passengers and 12 cars or the equivalent freight loads. It would be surprising, however, if the versatile South Marston team were to confine its thoughts at this stage entirely to these particular proposals. Doubtless it has other applications and ideas for cushion-riding craft in mind.

The fourth member of the quadripartite "Hovercraft Club"—William Denny and Brothers—is rather more remote from aeronautical interest than the other three. The Denny project is a large over-water ferry capable of speeds of around 30-40 knots. Little information is available but it is believed to be of the side-wall type—that is to say the "hull" has side keels—or walls—which remain immersed when the vehicle is riding on its cushion, and air curtains are provided only at the front and rear.

It has been reported that, as a step towards this project, a 15-ft. model is nearing completion at the company's Dumbarton shipyard. This model is said to weigh about a ton.

As already mentioned, there is a fifth member of the hovercraft industry in this country which, so far, has remained outside the H.D.L. group. To this "independent"—Britten-Norman, Ltd., of Bembridge, on the Isle of Wight—went the distinction of producing Britain's second air-riding research craft.

Known as the Cushioncraft, this vehicle made its début at the end of June and since then some 17-20 hr. of development "flying" have been completed. Intended as an operational research vehicle, the Cushioncraft differs from the Saro SR-N1 in having a large peripheral rotor to provide the air curtain. This is driven by a simple friction arrangement comprising an automobile wheel in contact with its rim and driven from a Coventry Climax car engine. Forward thrust and directional control is by two differentially operated helicopter tail rotors acting as pusher propellers.

The first "flights" with this craft brought to light a number of problems which have since been overcome. For example, the large peripheral rotor proved to be so gyroscopically stable that when the machine pitched for any reason a corresponding roll developed and a circular oscillation could be set up. This necessitated the introduction of a measure of destabilization and there are now 216 stator blades below the rotor in the main duct.

Fairly early, too, it was found that with the two forward-propulsion rotors, direction control was difficult to achieve and a comparatively large swept fin is now a feature of the craft. It was also found that with the automobile gearbox used, the propeller r.p.m. that could be obtained were not high enough and the differential thrust available for directional control was not sufficient.

This, coupled with the fact that to get the required main rotor r.p.m., bottom gear had to be used—in effect, it was a case of a "short-life" gear being used for continuous operation—led to the conclusion that a special gearbox would be needed. Therefore a single-speed spur-gear unit has been made especially for the Cushioncraft. In addition to being a much simpler unit this gives about twice the propulsion rotor r.p.m. than the original automobile gearbox.

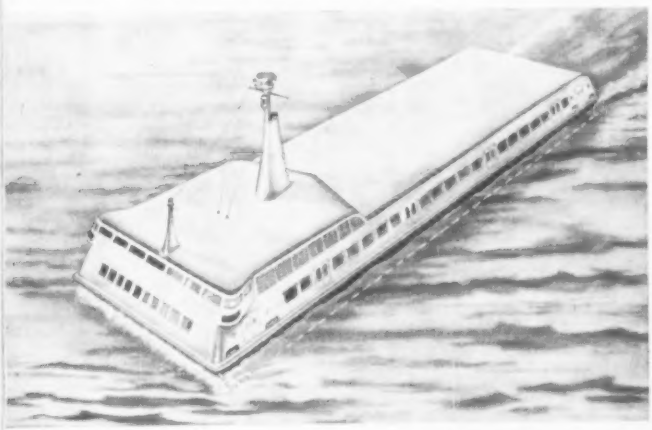
Another mechanical problem that arose was that the solid rubber-tyred Auster tailwheel units used as bearings for the main lift rotor tended to burn under the friction loads imposed. These tyres have now been replaced by Duthane ones made by Dunlop.

A form of roll control has also been found necessary for the Cushioncraft. This has been provided by having three of the lift duct segments on each side fitted with small flaps which would partially close the duct in those areas and act as lift spoilers. These flaps—each side trio acting together—are operated through pedals in the cockpit.

It seems fairly clear now that the Cushioncraft has already served a most useful purpose as an experimental craft from which a good deal of valuable experience has been built up. The Bembridge team already have something larger and more ambitious in mind; it may bear little resemblance to their first-generation craft but it will certainly embody many of the lessons learned.

Indeed, this sort of trial and error approach is part and parcel of the whole air-cushion-craft business at the present stage of its progress. Enough has been said in these notes to have shown that in this country, the work that is being done is extensive and that the projects that are in the early study phases are as imaginative and practical as any to be found elsewhere in the World. Technologically, the practical experience gained during the past two years or so has given us an invaluable lead in a new area of development which offers remarkable prizes.

However, radical advances have a habit of taking time to bring properly to fruition and it would be a great pity if, because of premature enthusiasm—understandable though it might be—the apparent slowness of progress were to be seen out of perspective. There is nothing more disheartening to those anxious and trying to make progress than to be thought guilty of holding it up. *Festina lente* is still good counsel, even in a highly competitive world.—F. T. MEACOCK.



Above, an artist's impression of the Denny project for a huge cushion-riding river ferry.

Right, the SR-N1 arriving at Dover after its Channel crossing and arousing great interest among the holidaymakers. This trip was made before the Marboré turbojet was added.

International VTOL Survey . . . .

Helicopters and VTOL Aircraft Surveyed

On this and the following ten pages we give information about the principal rotary-wing and VTOL aircraft in production or under active development throughout the World. Technical data are tabulated on pages 781 to 783.

BRAZIL

BAUMGARTL PB-64

—Best remembered for the tiny Heliofly strap-on helicopters with which he experimented in Austria during the War, Paul Baumgartl has been continuing his work in Brazil since 1948. His PB-60, a 100-lb. rotor-kite, was followed by the PB-63 single-seat light helicopter of conventional single-rotor layout.

Now, utilizing two pulse-jets developed by the Departamento de Motores of the official Brazilian Centro Technico de Aeronautica, he has progressed in the PB-64 to an ultra-light tip-driven helicopter with a difference.

The engines, instead of being mounted on the blade-tips, are carried by a dual-purpose driving-stabilizing bar at 90° to the rotor. This is claimed to reduce blade stresses, improve autorotative performance and give better control and stability.

BEIJA-FLOR BF-1

—The V-type intermeshing twin tail rotors of the two-seat Beija-Flor are a feature also of the German Borgward Kolibri. Both were designed by Prof. Heinrich Focke, whose pre-War Fw 61 was one of the first helicopters to have a really practical performance.

His brief on the Beija-Flor project was to use materials almost entirely of Brazilian origin. Because of the undeveloped state of the aircraft and accessory industries in that country, the result was a high structure weight in the prototype.

It is hoped to remedy this in the pre-series of three production models now under construction. Meanwhile the prototype has logged well over 100 flying hours.

GREAT BRITAIN

HAWKER P.1127

—To combine the performance of the Hunter, or better, with the VTOL characteristics of a helicopter was the aim of Sir Sydney Camm and his design team when they started work on the P.1127. Vertical take-off and landing were made possible by Bristol Siddeley's unique swivelling-nozzle BS.53 turbofan and brilliant engineering has taken care of the rest.

No deadweight lifting engines have to be carried around in cruising flight and a thorough test programme has already proved the reliability of the rotating nozzles. When a take-off run is possible, either normal or short with the nozzles partly swivelled, a heavy overload of fuel or weapons becomes practicable. This technique could revolutionize technical fighter operations. A photograph, three-view drawing and full description appear on pages 766 and 767 of this issue.

SHORT SC.1

—Rolls-Royce's formula of using low-specific-weight lift engines for VTOL flight, pioneered with the "Flying Bedstead" and brought to a high degree of efficiency with the SC.1, holds tremendous promise for the supersonic airliners and other high-speed types of the future.

In combination with Short's advanced auto-stabilizer and control system, it made the SC.1 the undoubted star of this year's S.B.A.C. Display. The principle was already well known, with a bank of four RB.108 turbojets for vertical lift and a fifth RB.108 in the tail for forward thrust. The SC.1 displays none of the marginal stability or hesitant transition associated with many experimental VTOL types. It made its first full transition on Apr. 6, 1960.

WESTLAND WIDGEON

—This roomy five-seat development of the original Sikorsky S-51 is in service from Hong Kong to Jordan and Brazil. To the 500-b.h.p. Leonides engine of Westland's version of the S-51, the Dragonfly, is added a completely new front fuselage, with a nose-door for stretcher-loading, and an S-55 Whirlwind-type rotor head.

The Widgeon can be supplied as a new aircraft or as a conversion of the Dragonfly, on wheels or pontoons. Optional extras include a hydraulic winch, sonar housing for anti-submarine duties and crop-spraying equipment.

WESTLAND WHIRLWIND SERIES 2

—Having acquired a licence to build the S-55 in 1952, Westland's early Whirlwinds differed little from the basic Sikorsky models. A major change was introduced in 1955 with the Series 2, adapted to take the British Leonides Major engine.

This version has been supplied to the Royal Navy in large numbers as the Whirlwind HAS.7 anti-submarine helicopter, with provision for carrying radar, dipping asdic and homing weapons. Others serve with military and commercial operators in many countries.

Two specially equipped Whirlwind HCC.8s form the helicopter component of The Queen's Flight.

Top, Westland Wessex Mk. 1. Above, Westland Scout P.531-2.

Above left, Westland Gnome-Whirlwind. Left, Westland Belvedere.

WESTLAND GNOME-WHIRLWIND

—Joining the Whirlwind Series 1 and 2 in production at Yeovil is this new model powered by a de Havilland Gnome shaft-turbine. Performance is improved considerably, especially at high altitude and in high temperatures.

The Royal Air Force has already placed a substantial order for the Gnome-Whirlwind, which will be designated HAR.10. There are plans also to re-engine the R.A.F.'s piston-engined Whirlwinds in due course.

WESTLAND WESSEX SERIES 1 AND 2

—Like the Widgeon and Whirlwind, the Wessex is a licence-built Sikorsky design, in this case the S-58. Adaptation to take a British powerplant led in this case to installation of a Napier Gazelle shaft-turbine.

The Wessex was the first large turbine-powered helicopter to enter production. It is in service with the Royal Navy as the Wessex HAS.1, a combined anti-submarine search-strike aircraft.

Under development is the Wessex 2, powered by two Gnomes and with a considerably increased payload and performance.

WESTLAND BELVEDERE

—Known as the Bristol 192 before the Westland company acquired the Bristol Aircraft helicopter interests, the Belvedere was flown for the first time on Jly. 5, 1958, and is now

in production for the Royal Air Force. Thirty are being delivered.

One of these helicopters showed its paces last June by achieving an overall average speed of 130 m.p.h., excluding stops, when it flew from Britain to North Africa for tropical trials. Standard payloads include 18-25 troops, 8-12 stretcher cases or 6,000 lb. freight.

In a flying crane rôle, loads of up to 5,250 lb. can be hauled externally. Several commercial developments have been proposed, including the Type 194 with four Gnomes, which have been offered to B.E.A.

WESTLAND ROTODYNE

—Development of this potential 54-70-passenger VTOL commercial transport—originally designed by the Fairey Company—is now being financed by a £4 million government contract, to which a further £1.5 million will be added towards the cost of introducing the type into service with B.E.A. in due course. New York Airways have said they will have five, with an option on 15 more, subject to satisfactory guarantees.

B.E.A. are thinking in terms of six, with an option on 14. Negotiations for a military version for the Army have been under way for some time. Deliveries are scheduled for 1964-65.

WESTLAND SKEETER

—Twelve years of development made the last production versions of the two-seat Skeeter very different from the original Cierva-built prototype, which flew on October 10, 1948, with a 106 h.p. Jameson engine. The most important of the many variants are the A.O.P.10 (200-b.h.p. Gipsy Major 200) and A.O.P.12 (215-b.h.p. Gipsy Major 215) for the British Army and the similar Mks. 50 and 51 for the West German Air Force and Navy.

During 1960, the Saunders-Roe division of Westland have developed a skid undercarriage for the Skeeter, which may be retro-fitted to the Army machines. One airframe has been re-engined with a Blackburn Turmo shaft-turbine and is being used to develop auto-stabiliser equipment.

WESTLAND P.531

—Britain's counterpart to the Alouette, this helicopter started life as a private-venture turbine-powered development of the Skeeter, powered by a 325-s.h.p. Turmo 601 shaft-turbine and carrying five people. The links with the Skeeter have long been severed and the P.531-2 Mk. 1, ordered for the British Army as the Scout, has a 968-s.h.p. (derated to 650-s.h.p.) Blackburn Nimbus shaft-turbine and an outstanding performance.

Following tests with a pre-production batch of three Turmo-powered P.531-O/Ns, which demonstrated their ability to operate from a small platform on a frigate in quite rough seas, the Navy also has decided to buy P.531s. These will carry a pair of homing torpedoes under the fuselage for anti-submarine work, operating from small escort vessels.

CANADA

AVIAN 2/180 GYROPLANE

—Development of this two-seat autogyro has been delayed by an accident to the prototype early this year, which was not caused by any fault in the aircraft. A replacement is being built and Avian hope to complete flight tests and put the Gyroplane into production during 1961.

The prototype (Model 2/180B) had a mechanical drive-shaft to the rotor, but the production 2/180A will have a conventional unpowered three-blade rotor and a ducted propeller at the tail for propulsion. For jump-starts, the rotor will be tip-driven from a compressed air bottle, which will be recharged in flight.

AVRO AVROCAR (VZ-9V)

—Developed under contract from the U.S. Department of Defense, as Weapon System 606A, the VZ-9V Avrocar is no mere ground effect vehicle or "flying-Jeep." Three Continental J69 turbojets drive a central fan which provides a high-pressure peripheral air curtain for vertical take-off and landing.

In forward flight the body of the Avrocar is intended to provide sufficient lift to permit cruising at high altitudes and at speeds up to 300 m.p.h. The prototype, which flew for the first time on Dec. 5, 1959, has been taken to California for further wind-tunnel and flight testing.

CZECHOSLOVAKIA

HC-2 HELI-BABY

—Prototypes of this two-seat light helicopter have been under test for several years, powered by an 83-b.h.p. Praga DH engine. In the initial series of 200 production models, now reported to be under construction, this will be replaced by a 105-b.h.p. M 110, developed especially for the HC-2.

Layout is conventional, with a three-blade main rotor and two-blade tail rotor. Space for cargo or equipment is provided on the C.G. and the usual accessories will be available, including spray-booms for crop-spraying.

HC-3

—First details of this five-seat general-purpose helicopter were released this summer, but it is not yet known whether flight testing has started. The HC-3 is conventional in layout, with three-blade main and tail rotors, driven by a 240-b.h.p. M 108H six-cylinder horizontally opposed engine.

In addition to passenger and freight transport duties, the HC-3 is intended for use in training, air ambulance, agricultural and search and rescue rôles.

FRANCE

HELICOP-AIR GIRHEL

—This little side-by-side two-seat autogyro put in a surprise appearance at the last Paris *Salon*. It was stated that two versions were under development.

The Girhel L50, of which the prototype is representative, has a 90-b.h.p. Continental C90 engine and range of 310 miles at 87 m.p.h. with a pilot and 220 lb. payload. The Girhel L51 has a 150-b.h.p. Lycoming engine and range of 620 miles at 112 m.p.h. with two passengers and baggage.

Design is conventional, with a mechanical drive from the engine for jump starts. Small wings, spanning 19 ft. 8 in., off-load the three-blade rotor in cruising flight.

SUD-AVIATION S.E.3210 FRELON

—The S.E.3210 is the production version of the Frelon, with three 1,250-s.h.p. Turbomeca Turmo IIIC shaft-turbines. The two prototypes, of which the first flew on Jne. 10, 1959, are designated S.E.3200 and have 750-800-s.h.p. Turmo IIIBs.

By carrying fuel in two outboard tanks, one on each side of the fuselage, Sud-Aviation have been able to provide an unobstructed cabin almost 23 ft. long by 6 ft. 3 in. wide and 6 ft. high. This gives ample room for 28 fully equipped troops for short-range operations (up to 60 miles) or two tons of freight on medium stages (up to 185 miles).

Fifteen stretcher patients and two attendants can be carried 250 miles. Military versions can be armed with four Nord SS.11 wire-guided missiles or anti-submarine search and strike equipment.

SUD-AVIATION S.E.3130 ALOUETTE II

—One of the most successful products of the French aircraft industry, the Alouette is leaving the assembly line at the rate of 16 per month and 432 had been delivered by September of this year. Orders then stood at 598.

Recent orders and re-orders, notably by the West German Government, however, are enabling Sud-Aviation to plan production of at least 700, including those assembled by Republic in the United States and Saab in Sweden. Normal accommodation is for a pilot and four passengers.

SUD-AVIATION S.E.3160 ALOUETTE III

—The Alouette III was evolved from the Alouette II via the S.E.3131 Gouverneur with enclosed fuselage and the S.E.3150 with an early Artouste III shaft-turbine. Its Artouste IIIB gives considerably more power than the Artouste II of its predecessor.

It can carry a pilot and six passengers or, with the side doors removed, eight troops facing outward, with their legs dangling over the side. The first of two prototypes flew on Feb. 28, 1959, and Sud-Aviation hope to start delivery of an initial batch of 200 during 1961.

Top, Avro Avrocar VZ-9V. Above, Sud S.E. 3160 Alouette III.

SUD-AVIATION S.O.1221 DJINN

—The Djinn was the first helicopter to feature a cold-jet rotor, tip-driven by compressed air from a turbo-generator without any form of combustion in the nozzles. It first flew on Dec. 16, 1953, and 150 have been built for service in 11 countries.

Standard payload comprises a pilot and passenger side by side in the cabin, but the Djinn is also used widely for crop-spraying and as a light military casualty evacuation aircraft with an external litter on each side of the fuselage.

WEST GERMANY

BORGWARD KOLIBRI 1

—First post-War helicopter of German design to fly successfully, the Kolibri was designed by Prof. Heinrich Focke and has much in common with the Beija-Flor which he designed earlier in Brazil. The engine is moved from the nose to a more traditional position aft of the cabin, but the Kolibri retains the Beija-Flor's twin intermeshing tail rotors.

The prototype was first flown on Jly. 8, 1958, by Ewald Rohlfs who did much of the testing of the pre-War Focke-Wulf Fw 61 helicopter. Trials have gone well and Borgward are planning to put the Kolibri into production as a transport for a pilot and two passengers, two stretchers or 660 lb. of freight.

International VTOL Survey . . . .

ITALY

AGUSTA AZ 101G

—A little-known fact about the AZ 101G is that Piasecki Aircraft of Philadelphia, U.S.A., have contributed to its engineering and development. With three de Havilland Gnome shaft-turbines, it is therefore quite an "international" project and its performance estimates might well foreshadow even more international sales.

With a higher gross weight than either the Sud-Aviation Frelon or Sikorsky S-61, the AZ 101G is designed to carry up to 30 passengers, 16 stretcher patients or equivalent freight. Both the rear loading ramp and nose-doors can be left open in flight to enable lengthy loads to be accommodated semi-internally as an alternative to the more usual under-fuselage flying crane technique. First flight is imminent.

AGUSTA-BELL MODEL 102

—As a follow-up to their highly successful licence production of the Bell 47, Agusta have developed this attractive 9-10-seat general-purpose helicopter from the original Bell Model 48. Production is already under way, with three destined for service with Elivie, the helicopter-operating associate of Alitalia, in the Naples area.

Up to 1,940 lb. of freight can be carried internally or externally. The cabin is large enough to take four stretchers and an electric winch can be fitted for rescue operations. The prototype Model 102 flew for the first time on February 3, 1959.

AGUSTA A 103

—The prototype of this little single-seater has been flying successfully since October, 1959. It is an all-Agusta product, being powered by one of the company's own range of light aero-engines, although the Bell-type rotor system, with stabilizer bar, is utilized.

Despite its relatively low power (85 b.h.p.), the A 103 has a maximum speed of 93 m.p.h. and a hovering ceiling of 2,000 ft. out of ground effect. This has encouraged Agusta to develop from it the A 104 Helicar, as described below.

AGUSTA A 104 HELICAR

—Even the best single-seat helicopter has its limitations, so Agusta have scaled-up the A 103 very slightly to produce the two-seat A 104. Again the powerplant is one of their own range, the 140 b.h.p. (derated to 120 b.h.p.) M.V. A 120 flat-four, driving a Bell-type two-blade rotor system.

Seats are side by side, with provision for dual controls, auto-pilot and hydraulic boost system. An under-fuselage hook takes care of bulky freight loads and Agusta plan to adapt the aircraft for all the usual agricultural, observation and general aviation duties.

FIAT MODEL 7002

—A prototype of this extremely practical helicopter was completed at least eight months ago, but flight trials have had to wait development of its Fiat 4700 turbo-generator.

Design-wise, the Model 7002 would be difficult to improve. It is, unashamedly, a square-section box of maximum roominess and minimum structure weight, hung under a massive two-blade rotor, with the engine aft of the cabin, the fuel tanks above it, and a short tail-boom for the ducted tail rotor.

The rotor is tip-driven by "cold-jets," without combustion at the nozzles, and it is hoped to carry a pilot and six passengers.

LUALDI L.59

—Those fortunate enough to have seen the L.59 prototype at the Venice Air Show last summer will not need to be told that this is one of the neatest and best-designed four-seaters in the air. Despite its small size, the cabin is very roomy.

Nor has the field of vision suffered overmuch by the car-type engine position, under a bonnet at the front. Windows all round the cabin give a virtual 360° lateral view and the sides are also well glazed. Engine accessibility has been given special attention and the ejector exhaust system is claimed to offer a useful power bonus.

Fuel is carried in tanks above the cabin. The prototype, built in co-operation with the Italian A.R.B. and American F.A.A., has been bought by the Italian Army.

Agusta A 103.

JAPAN

HAGIWARA HCX-4

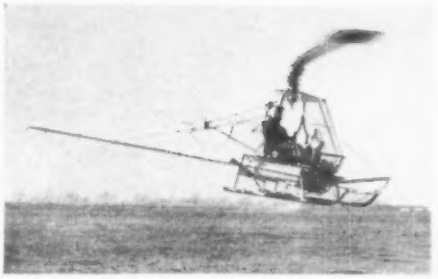
—Eight years of development have brought the Hagiwara single-seat light helicopter to its present configuration. The original prototype had blade-tip pulse-jets which proved so noisy and difficult to ignite that the switch to ramjets was made in 1955.

For a time the cabin was enclosed, but the fourth prototype has been stripped of all non-essential structure in the interests of performance and payload. In addition to work on the HCX-4, Mr. Hagiwara has built and tested at least three small ground-effect vehicles in recent months.

NETHERLANDS

NHI H-3 KOLIBRIE

—Although far from handsome, the little ramjet-powered Kolibrie comes very near to the ideal of a simple airborne prime mover for two people or a pilot and 825 lb. of assorted payloads. Up to four 100-litre (22 Imp. gal.) fuel tanks can be slung under the cabin, for varying range/payload requirements.



NHI H-3 Kolibrie.

One, two or three of the tanks can carry liquid chemicals in the sprayplane rôle which has become the Kolibrie's main application.

Except for the rotor blades, which are manufactured by Fokker, Aviolanda now build the entire aircraft and its engines, having taken over management of the NHI company in May, 1959. They are currently producing a second series of 10, with 51-lb.s.t. TJ5A ramjets, in place of the 44-lb.s.t. TJ5s of the original series. The latter can be modified easily to the latest standards.

SOVIET UNION

KAMOV Ka-15

—By comparison with other Soviet helicopters, little is heard of the two-seat Ka-15. This may imply that its uses are mainly military, and it has certainly been taken on board Soviet warships for anti-submarine duties.

Others are reported to be used for agricultural work and Aeroflot are known to have evaluated a version designated Ka-15M for air ambulance work, with two external stretcher panniers. Proof of the aircraft's capabilities is given by its F.A.I.-recognized records of 101.19 m.p.h. over a 100-km. closed circuit and 105.91 m.p.h. over a 500-km. circuit.

KAMOV Ka-18

—This is a four-seat version of the Ka-15, using the same 275-b.h.p. Ivchenko AI-14V engine and coaxial contrarotating three-blade rotor system. The fuselage has been lengthened and, according to U.S. engineers who have flown the Ka-18, the result is a roomy, versatile and pleasant-to-fly helicopter.

It is used by Aeroflot for taxi, mail delivery and crop-spraying duties and is now being offered for general commercial sale, including export. The data for this aircraft given in the table on page 781 and those for the Mi-1 and Mi-4, are taken from officially supplied Soviet sales brochures.

(*Continued on page 775*)

Far left, Fiat 7002.
Left, Lualdi L.59.

Whirlwind 10

Wessex 2

Agusta 101G

Agusta Bell 204B

Vertol 107

Sikorsky S-61

Sikorsky S-62

Kaman HU2K

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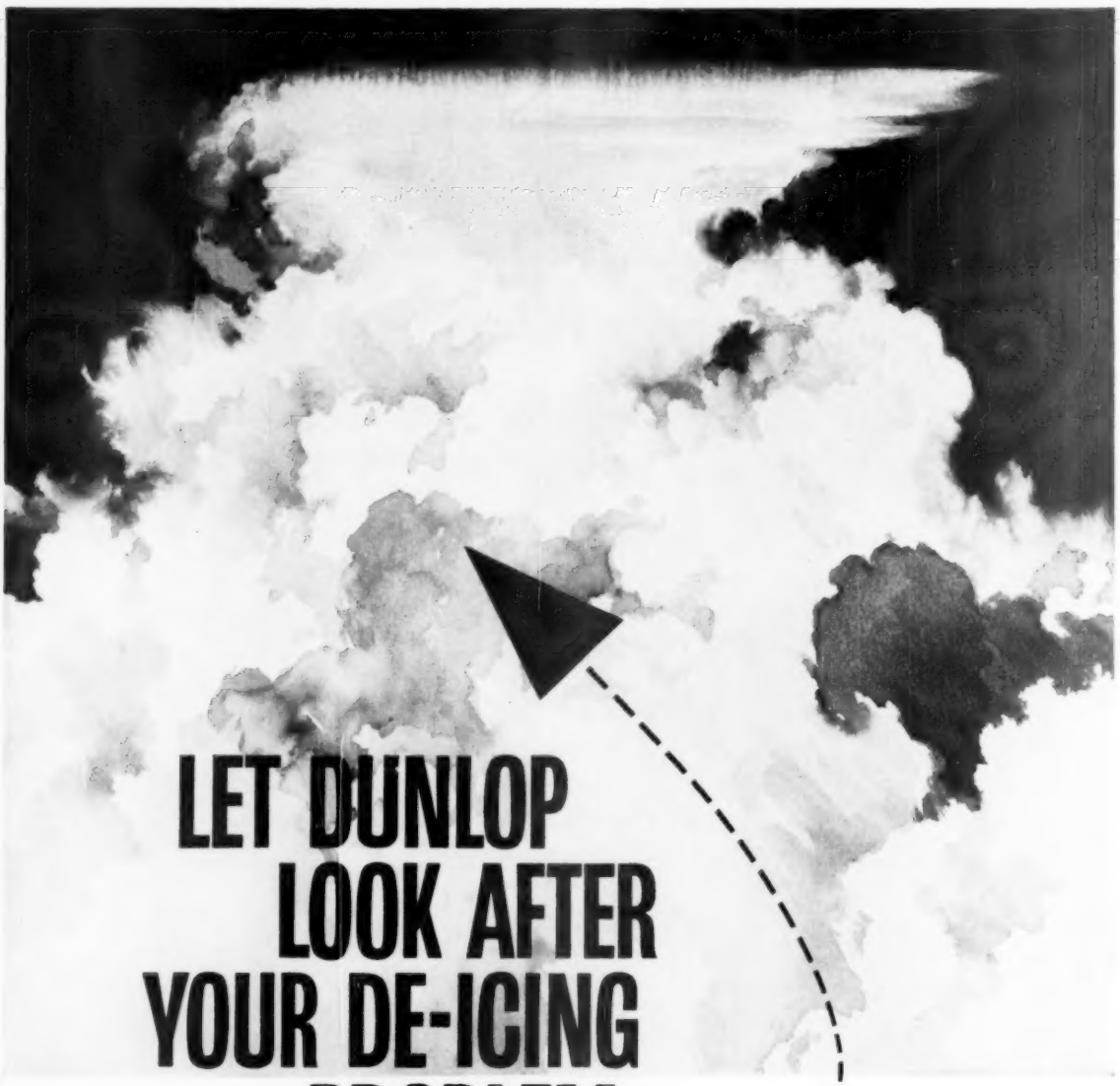

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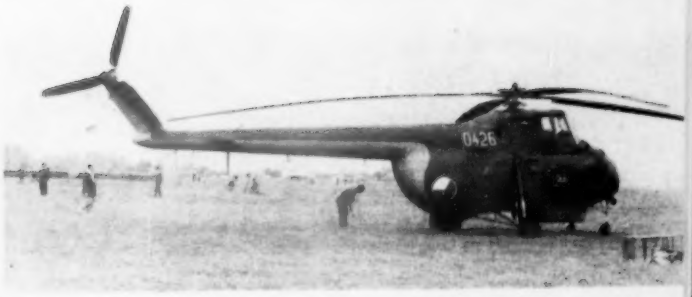


Kamov Ka-18 (top left), Mil Mi-4 (above), and Mil Mi-6 (left).

International VTOL Survey . . . .

SOVIET UNION (Contd.)

MIL Mi-1 and MOSKVICH

—First Russian helicopter to go into large-scale production, the Mi-1 has by no means reached the end of its development potential, as was proved by the appearance this summer of the Moskvich. Although similar in general appearance to the earlier versions, this is much improved in both the standard of passenger accommodation and flying characteristics.

The rotor blades are now all-metal, controls are hydraulically powered and the aircraft is cleared for day and night all-weather flying. Like the standard Mi-1NKh, it carries a pilot and three passengers, with provision for external stretcher panniers (accessible from the cabin, through "tunnels," to enable the patients to be tended in flight), mail canisters, crop-spraying gear, pontoons and other accessories. The Mi-1NKh is built also in Poland as the SM-1 and five-seat SM-2.

MIL Mi-4

—One of the best helicopters of its class in the World, the Mi-4 is the mainstay of both Aeroflot's 6,000 miles of helicopter passenger routes and the Soviet Armed Forces' rotary-wing units. Many have been exported to Egypt, Austria, Belgium, the Yemen, Cuba, India, Italy, Switzerland and other countries.

The standard military Mi-4, which entered production in 1952, carries 14 troops, or 3,520 lb. of frieght or vehicles, which are loaded through clamshell rear doors. Normal accommodation in Aeroflot's Mi-4Ps is for 8-11 passengers, with toilet, wardrobe and baggage space.

This version can be recognized by its larger, square windows and usually spatted wheels. The widely used agricultural version is the Mi-4S.

MIL Mi-6

—Very little has been heard recently of the Mi-6, which is by far the largest helicopter yet flown and still holds the helicopter speed record of 167.206 m.p.h., plus three payload-to-height records. One report has stated that five were built for development testing and that 30 have been ordered for survey work in Siberia.

The November 24 issue of *Soviet Weekly*, in a feature on Russia's commercial helicopter operations, referred to it as "one of the most popular of the larger helicraft," but there is no confirmation of its being in service. At the time of its first crop of record-breaking flights, in October, 1957, it was stated to have normal seating for 80 passengers, with room for up to 120 on high-density routes.

In one of its weight-lifting flights, it carried a payload of 26,464 lb. to a height of 2,000 m. This payload is greater than the all-up weight of any other current helicopters except the Sikorsky S-56 and S-60, Yak-24, and Westland Rotodyne.

YAKOVLEV Yak-24

—More than eight years after its development was started, this big twin-engined tandem-rotor helicopter is entering service with Aeroflot under the designation Yak-24K. Identifiable by its large square windows, this version has eight seats in two rows with a centre aisle and is said to cruise at 116 m.p.h.

Its fuselage is considerably shorter than that of the military Yak-24, which has been in service for some five years and carries up to 40 troops, or freight and vehicles. Originally the Yak-24 utilized two Mi-4 engine-transmission-rotor systems; but the latest versions have a 10-ft. increase in rotor diameter and much-revised tail surfaces.

SPAIN

AEROTECNICA AC-12

—The "AC" in the designation of this two-seat light helicopter stands for Aerotecnica-Cantinieau, and it is a direct development of the MC-101 light helicopter built by Matra in France in 1952 to the design of Jean Cantinieau. M. Cantinieau has since been responsible for all Aerotecnica helicopter projects.

His engine-over-the-cabin configuration, pioneered by the MC-101, and retained in the subsequent designs, has been followed by many other companies. In the AC-12, which flew in prototype form on Jly. 20, 1956, the engine drives a three-blade rotor via a transmission and reduction gear built on automotive principles.

The Spanish Government ordered a production batch of 12, with the military designation XZ-1.

AEROTECNICA AC-14

—A five-seater, the AC-14 is considerably larger than the AC-12, but follows the same general configuration. Main difference is that the AC-12's tail rotor is replaced by a jet-deflection nozzle at the tail, which uses residual thrust from the Artouste shaft-turbine to provide anti-torque control in vertical and low-speed flight.

During cruising flight the residual thrust is used to increase forward speed, torque control then being provided by the two small rudders. Six AC-14s were ordered by the Spanish Government, under the designation XZ-4, and the first of these flew on Jly. 16, 1957.

U.S.A.

BELL MODEL 47G-3 TROOPER

—Since the prototype Bell 47 flew in 1945, well over 2,500 aircraft of this basic type have been bought by civilian and military customers. More than half of this total have gone to the U.S. Services (designation H-13, HTL), and they were widely and successfully used for front-line casualty evacuation duties in Korea.

The performance of the latest Model 47G-3, particularly at high altitudes, shows a vast improvement over that of the early versions. In place of their 178-b.h.p. Franklin engine it has the new turbo-supercharged Franklin 6VS-335, which maintains its full sea-level rating of 225 b.h.p. up to 15,000 ft.

The 47G-2 is also still in production with a 260-b.h.p. (derated to 200 b.h.p.) Lycoming VO-435. The 47 series is manufactured in Italy by Agusta and in Japan by Kawasaki; Merckle are assembling 60 Agusta-built 47s in Germany.

BELL MODEL 47J-2 RANGER

—The Ranger was introduced as a dual-purpose utility/de luxe version of the Model 47 with a lengthened, streamlined cabin seating four persons instead of the usual three. It is used for a wide variety of commercial applications.

In addition, the U.S. Navy ordered 18 HTL-7s for basic and instrument flight training; HUL-1s for utility duties and ice-breaker patrol; and two HUL-1Cs for the Coast Guard. Two HUL-2s are now being built with 250-s.h.p. Allison YT63-A-3 shaft-turbines for evaluation.

Two de luxe Model 47s were supplied to the U.S.A.F., under the designation H-13J, and intended specifically for use by the President and his aides.

BELL MODEL 204

—Destined to become the U.S. Army's standard utility helicopter, the Model 204 was first flown in prototype form on Oct. 22.

Bell 47J Ranger four-seat helicopter.

International VTOL Survey . . . .

Top, Bell HU-1A Iroquois. Above, Bensen B-10 Prop-Copter.

U.S.A. (Contd.)

1956, with the designation XH-40. Three XH-40s and six YH-40s were followed in mid-1959 by the first of nine pre-production aircraft, re-designated HU-1A Iroquois, and deliveries of an initial production batch of 100 began last spring.

This version has a 700-s.h.p. Lycoming T53-L-1 shaft-turbine and carries a pilot and five passengers or 3,000 lb. of freight. The HU-1B (commercial Model 204B) has a 1,000-s.h.p. T53-L-5 and seats for eight passengers.

The HU-1D will have a 1,100-s.h.p. T53-L-9 and a longer cabin accommodating 12 troops. Variants are the instrument trainer version of the HU-1A, of which the U.S. Army is having 14, and the commercial 204B built in Italy by Agusta with a D.H. Gnome shaft-turbine.

BELL X-14

—This small jet-deflection research aircraft is back in the news following NASA's decision to re-engine it with two General Electric J85s, to evaluate these engines as powerplants for VTOL flight.

It flew originally with a pair of Bristol Siddeley Vipers and showed its paces in May, 1958, when it rose vertically from a runway at Edwards AFB, made a transition to forward flight, circled the airfield at 160 m.p.h. and then returned to its starting point, hovered and landed. The jet-deflectors are mounted aft of the engines and are able to divert the jet efflux at any angle from vertically downward to horizontal for normal cruising flight.

BELL XV-3

—Development of this fixed-wing/tilting-rotor convertiplane is being continued under a contract awarded in 1959. First flown on Aug. 23, 1955, the original prototype was written off in a crash landing in October of the following year after making 15° transitions from vertical to forward flight.

A change from three-blade to two-blade rotor/airscrews was made in the second prototype and on Dec. 18, 1958, this aircraft made its first full conversion, taking off helicopter-fashion with the plane of the rotors parallel to the ground, and then tilting the rotors forward and down through 90° for forward flight, with the fixed-wings providing all necessary lift. Since then it has repeated this transition regularly.

BENSEN B-8M GYRO-COPTER

—Like Topsy, this little craft "just growed" from the unpowered Gyro-Glider rotor-kites which Igor Bensen has been mass-producing as finished aircraft and in kit form for many years. Youngsters of 10 are said to have built their own Gyro-Gliders and learned to fly them when towed behind a car.

The same rotor-kite on floats instead of wheels becomes the Hydro-Glider. With a dinghy hull instead of floats, as the Gyro-Boat, it becomes a flying-boat.

The Gyro-Copter is the same basic airframe with a target drone engine mounted aft of the rotor pylon. Either overhead or floor control columns can now be used, and a mechanical drive can be fitted for jump-starts.

BENSEN B-9 LITTLE ZIPSTER

—First helicopter produced by Bensen, the Little Zipster has been offered commercially since early 1960. Its general configuration is very like that of the Gyro-Copter, but it has co-axial contra-rotating powered rotors.

The familiar Bensen overhead stick control is retained to tilt the entire rotor head and so dispense with the usual complex rotor head mechanism. It is claimed to be very simple to fly, but construction is less easy than that of the Gyro-Copter and the Little Zipster is being produced only in ready-to-fly form.

Bensen B-9 Little Zipster.

BENSEN B-10 PROP-COPTER

—With this experimental VTOL prototype, Igor Bensen has attempted to produce a very simple form of "flying jeep." A standard McCulloch drone engine is mounted at each end of a rectangular vertical frame, driving 50-in. diameter horizontal airscrews.

The pilot sits astride the frame and controls the aircraft by means of air deflector vanes operating in the propeller slipstream. Few details have been released, except that the prototype flew for the first time on Aug. 6, 1958, and is still under development.

BOEING-VERTOL MODEL 107

—One of the most important helicopters currently in production in the United States, the Model 107 is the aircraft with which New York Airways plan to build up their network of passenger services in the early 'sixties and with which the U.S. Army will re-equip its helicopter assault units.

The prototype, which flew on Apr. 22, 1958, was designed as a 23-seat amphibious transport with two 850-s.h.p. Lycoming T53 shaft-turbines. It was followed by an evaluation batch of three YHC-1As for the U.S. Army with 850-s.h.p. General Electric T58-GE-6s, and one of these has been re-engined with 1,050-s.h.p. CT58-100s as the prototype of the commercial 107-II. It flew in this form on Oct. 25, 1960.

Major production version for the Army is the YHC-1B Chinook, a considerably larger aircraft with 1,940-s.h.p. Lycoming T55-L-5 engines and seats for up to 32 troops. Ten have been ordered to date.

BOEING-VERTOL MODEL 44

—Although superseded by the new Model 107 and YHC-1, the Model 44 and H-21 Work Horse tandem-rotor piston-engined helicopters continue in service in large numbers, not least on New York Airways thriving passenger network.

A total of 288 of the various versions of the H-21 were supplied to the U.S.A.F. and Army, for Arctic Rescue and as 22-troop assault transports. Twelve went to the R.C.A.F. The commercial Model 44 seats 14-15 passengers in airliner-style accommodation and is often fitted with large flotation bags around each wheel for emergency use. A military version is used for anti-submarine duties by the Swedish Navy.

BOEING-VERTOL MODEL 76 (VZ-2)

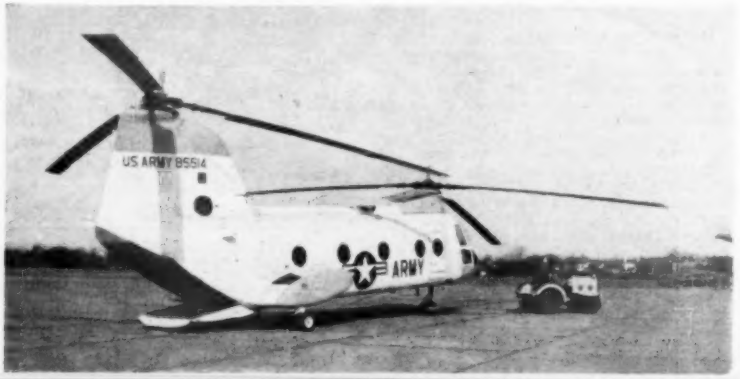
—First tilt-wing aeroplane to fly, in 1957, the VZ-2 also made the first successful transitions from vertical to horizontal flight and vice versa in July of the following year. It looks like what it is—the simplest possible research vehicle to prove the practicability of the tilt-wing technique, using existing components wherever possible to save money.

Two rotor/airscrews are driven by a single Lycoming YT53 shaft-turbine, which also drives vertical and horizontal ducted fans at the tail to provide control in hovering and vertical flight. The flight test programme is continuing under NASA sponsorship.

BRANTLY MODEL B-2

—First seen in England this summer, the B-2 is a two-seat ultra-light helicopter which flew for the first time in its original form on Feb. 21, 1953. The design has undergone considerable refinement since then and, following evaluation of a batch of five by

(*Continued on page 777*)



Boeing-Vertol YHC-1.

V.T.O.L

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Top, Curtiss-Wright X-100; above, Cessna CH-1C Skyhook.

(*Continued from page 776*)

the U.S. Army and Navy, under the designation YHO-3BR, the decision was taken to offer the type commercially.

Deliveries to corporate customers in America have been under way for nearly a year, and production was reported to be at the rate of two per week in mid-1960.

CAPITOL COPTER

—Latest of the single-seat light autogyros to enter production in America is the Capitol Copter, somewhat reminiscent of the Bensen Gyro-Copter in general configuration but more refined, with a glass-fibre and Plexiglas enclosed cabin for the pilot. The prototype flew for the first time in September, 1959, and Capitol hope to begin delivery of prefabricated kits for amateur assembly in the near future.

Two models will be available: the 3CWM300 on wheels and the 3CFM400 with reinforced glass-fibre floats. The rotor has a high-strength light-alloy spar and laminated wood skin, covered with a thin layer of glass-fibre, and has no collective-pitch mechanism.

CESSNA CH-1C SKYHOOK

—After more than six years of development, the four-seat CH-1 Skyhook helicopter has reached the stage where it can be added to Cessna's wide range of business aircraft. Since 10 of the CH-1B version were evaluated by the U.S. Army, under the designation YH-41 Seneca, mechanical and aerodynamic changes have been made which provide complete static and dynamic stability.

Features of the design are the nose mounting of the engine, for ease of accessibility, the use of only five gears in the main and tail rotor transmission systems, and a method of blade attachment which removes the need for pitch-change bearings. Production deliveries will begin next year.

CURTISS-WRIGHT VZ-7AP

—This "flying Jeep" was designed for the U.S. Army Transportation Corps by the former Aerophysics Development Corporation, which now operates as the Santa Barbara Division of Curtiss-Wright. First flown in 1959, it uses a single Artouste shaft-turbine to drive four small-diameter rotors.

A conventional collective-pitch lever is used for climb and descent. The control column changes the rotor pitch differentially for control in pitch and roll, and pedals operate a rudder in the jet efflux. Piloting techniques, aided by a stability augmenter, follow fairly orthodox helicopter practice.

Passengers, weapons or freight can be carried on a platform between the rotors.

CURTISS-WRIGHT X-100

—The first intimation of the existence of this VTOL research aircraft was an announcement by Curtiss-Wright last spring that it had completed successful transitions from vertical to forward flight and vice versa.

International VTOL Survey . . . .

In view of the smallness of its fixed wings, this fact bears out the company's claim that the completely new "radial lift-force" propellers with which it is fitted continue to provide lift even when they have been tilted down through 90° to provide propulsion for cruising flight. No details of how they work have been released, but Curtiss-Wright are reported to be building prototypes of a six-seat executive aircraft, designated Model 200, using "radial lift-force" propellers for VTOL operation.

A much larger project on the same lines is the 30-50-seat Model 300 feeder-liner.

DE LACKNER DH-5 AEROCYCLE

—De Lackner were the first company in America to attempt to simplify the one-man helicopter by turning it upside-down so that the pilot stood above the rotor. The result was the DH-4 Aerocycle and it was claimed that ordinary soldiers had learned to fly this aircraft in only 20 minutes. To change direction the pilot merely leaned in the direction he wished to travel.

The current DH-5 prototypes are slightly more complicated, having handlebars for steering and, in some cases, elevators for longitudinal control. The only other control is a twist-grip throttle for the engine.

DEL MAR DH-1 WHIRLYMITE

—Although a new name in the helicopter business, Del Mar are well known as suppliers of weapon system and training equipment. Their DH-1 Whirlymite is flying at present as a one-man rotorcycle powered by a 60-b.h.p. Kiekhaefer Mercury piston engine.

Ultimate version will be a pilotless drone, with a 65-s.h.p. Solar Titan shaft-turbine. Flown under remote control from the ground, this ultra-light flying crane could be used for supplying front-line areas in the battlefield, casualty evacuation and reconnaissance. Commercial versions are planned for production in 1961-62.

DOAK MODEL 16 (VZ-4DA)

—One of the most successful convertiplanes built to date, the VZ-4DA is a variant of the early tilting-rotor concept, with small-diameter ducted fans in place of rather clumsy large-diameter rotors.

Each of the ducts has 14 glass-fibre inlet guide vanes which are deflected for roll control in vertical and hovering flight. The fixed-pitch fans each have eight stainless-steel blades, and there are nine stainless-steel stator blades behind each of them.

Development was rapid. The prototype left the ground for the first time on Feb. 25, 1958. By September, 1959, it had completed its 50-hr. acceptance programme for the U.S. Army, including conversions.

DOMAN LZ-5-2

—Although this eight-seat general-purpose helicopter was awarded its approved Type Certificate as long ago as Dec. 30, 1955, attempts to get it into production in the United States and Canada met with no success. Now it is reported that a first batch of 25 is being laid down in Sicily by a new company named Aeronautica Sicula, an associate of Ambrosini.

Features of the LZ-5-2, which flew in prototype form on Apr. 27, 1953, include a hingeless rotor and a hydraulic rotor control system. The payload can be increased to 2,250 lb. for agricultural and freight duties by removing the accordian-type cabin doors and other non-structural components and skin covering.

GYRODYNE YRON-1 ROTORCYCLE

—Having started as a simple portable helicopter able to carry a soldier and 60-lb. pack a distance of about 12 miles, the YRON-1 will revert to this formula in a new version soon to begin flight tests. This will have a 62-s.h.p. Solar Titan shaft-turbine,, driving a 15-ft. rotor, and is planned for an overhaul life of 500-1,000 hr.

Meanwhile development of the current versions continues. These include the evaluation batch of three Model GCA-41As with 62-b.h.p. Porsche YO-95-2 and 17-ft. rotor, a GCA-41B with Titan and 17-ft. rotor, and a GCA-59 with 72-b.h.p. Porsche YO-95-6 and 20-ft. rotor.

GYRODYNE DSN-3

—This very important little drone helicopter is the airborne portion of the U.S. Navy's DASH (Destroyer Anti-Submarine Helicopter) weapon system which may eventually find its way on board all the Navy's light escort vessels. It consists of a simple steel-tube flying crane airframe, with the usual Gyrodyne co-axial contra-rotating rotor system, and with a payload of a single homing torpedo.

The idea is to fly it on submarine attack sorties under remote control from the launching ship in circumstances when the use of manned aircraft might involve high risk of loss. The automatic stabilization and remote-control equipment for the DSN has already been flight tested on a YRON-1 airframe.

Production versions are the DSN-1 with Porsche engine and DSN-3 with Boeing shaft-turbine.

HILLER MODEL 12E-4

—Evolution of Hiller's standard general-purpose light helicopter reached a major milestone this year with the appearance of the Model 12E-4, first version to seat four persons. The "mod" involves slicing through the cabin of a three-seat 12E and inserting a new section to lengthen it.

This means that standard 12Es can be brought up to 12E-4 standard easily and is part of Hiller's policy of supplying kits to up-rate the performance of the 12E. Other kits now available include dual carburetters and high-compression pistons, with a turbo-supercharger to follow next year, plus all the usual helicopter accessories.

Proof of the 12E's altitude performance was given last spring when it effected a rescue at 18,000 ft. on Mt. McKinley, Alaska. Meanwhile, production of the H-23D Raven (250-b.h.p. Lycoming) for the U.S. Army continues.

HILLER YROE-1 ROTORCYCLE

—The five YROE-1 Rotorcycles currently under evaluation by the U.S. Marine Corps represent an Anglo-American venture, as they were built under licence in the U.K. by the Saunders-Roe Division of Westland.

Original XROE-1 prototype, designed and manufactured by Hiller, flew on Jan. 10, 1957, and proved so promising that it was sent on a four-month demonstration tour

Top right, Gyrodyne YRON-1 Rotorcycle; right, Doman LZ-5-2.

International VTOL Survey . . . .

of U.S. military bases and NATO countries in Europe after completing its official flight tests in July of that year. A feature of the design is that the aircraft breaks down into a small package for transport and air-drop and can be reassembled by one man in 10 min.

HILLER X-18

—Largest VTOL research aircraft under test in America, the 33,000-lb. X-18 made its first take-off from Edwards Air Force Base on Nov. 24, 1959, as a conventional aircraft. In fully developed form, it will be able to take-off vertically with its wing tilted at 87° to the horizontal and with its 16-ft. 1-in. dia. Curtiss-Wright electric contra-props functioning as helicopter rotors.

Control during this phase will be by pitch-control nozzles at the tail, fed by a Westinghouse J34 turbojet, and by the ailerons working in the airscrew slipstream. A "mixer" unit enables standard flying controls to be used throughout the entire take-off and conversion sequence, the only additional control in the cockpit being a wing-tilt lever.

HUGHES MODEL 269A

—Deliveries of this attractive little two-seat ultra-light helicopter are scheduled to begin in four months' time and to reach a rate of one per day by next September. The decision to go ahead with manufacture on this scale was taken after a comprehensive evaluation programme of five YHO-2HU military models by the U.S. Army and after receipt of an F.A.A. Approved Type Certificate.

Structurally the Model 269A is simple and easy to maintain, with an overhaul life of over 1,000 hr. for all major components. It is entirely redesigned in comparison with the original prototyne Model 269 which first flew in October, 1956.

KAMAN H-43B HUSKIE

—Current orders for this turbine-powered development of the original HOK/HUK/H-43A piston-engined family are for 116 aircraft for the U.S.A.F. Most are being assigned to military airfields throughout the United States for local crash rescue duties, carrying a pilot, two fire-fighters in full protective garb and an under-fuselage pack comprising 1,000 lb. of fire extinguishing and rescue apparatus.

Use of the smaller, lighter, more powerful shaft-turbine, mounted above the rear of the cabin, has doubled the payload capacity and usable cabin space, and 12 people can be carried in the transport rôle. An H-43B holds the Class E-1d height record of 29,846 ft., set up last December.

KAMAN HU2K-1 SEASPRITE

—This turbine-powered utility helicopter is expected to replace in due course the several hundred assorted general-purpose helicopters now serving with the U.S. Navy. The prototype flew for the first time on Jly. 2, 1959, and has since undergone a very successful test programme.

An initial production order for 12 Seasprites was increased considerably a few weeks ago, and deliveries are due to start in mid-1961. Normal duties are to include plane guard, rescue, ambulance, flying crane, observation and passenger-carrying, with accommodation for a crew of two and 13 passengers in this last rôle.

KAMAN K-16B

—Like the Hiller X-18, which was built around the fuselage of a Chase YC-122 transport, this tilt-wing research aircraft for the U.S. Navy utilizes an existing airframe to cut costs. In this case, the complete hull and tail unit are those of a Grumman Goose amphibian, to which has been fitted a new wing and powerplant assembly.

One major difference compared with the X-18 is that the wing of the K-16B is intended to tilt no more than 50°. This is made possible by the use of very large Fowler flaps which will deflect the slipstream from the three-blade rotor-airscrews and so permit VTOL flight.

Small flaps on the airscrews will provide control in vertical flight when conventional flying control surfaces are ineffective.

McDONNELL MODEL 120

—This tiny flying-crane helicopter utilizes a pressure-jet rotor system to achieve remarkable vertical lift capabilities. It can, in fact, carry far more than its own empty weight at the end of a cable attached to a hook under its C.G.

A very-utility transport version has also been tested, with "toboggan seats" for 12 people mounted on cross-members between the undercarriage skids. A minor concession to comfort is the provision of side-screens to protect the passengers from wind and rotor downwash.

McDonnell claim that any one of the three AiResearch turbo-generators can be replaced in five minutes without tools. Other maintenance costs are clearly small, in view of the simplicity of the airframe.

MONTE-COPTER TRIPHIBIAN

—Little has been heard of progress with this compact three-seat amphibious helicopter since photographs of the prototype were released early this year. Its development dates back to the original Monte-Copter Model 10 prototype of 1955, which had a cold-jet rotor supplied with air from a compressor driven by a Lycoming engine.

Two Continental-built Palouste turbo-generators eventually replaced the piston engine and out of this experience grew the Triphibian. It has a glass-fibre hull, and the wingtip fuel tanks double as stabilizing floats on the water. The small delta-wings are intended to off-load the rotor in flight.

OMEGA BS-12D

—The prototype of this twin-engined utility helicopter set up something of a record when it flew for the first time on Dec. 26, 1956, only 90 min. after the finishing touches had been made to its airframe. The engines are mounted on outriggers and drive the main gearbox via a belt-drive system, with a clutch to ensure that either engine is disengaged automatically in the event of failure.

Normal seating is for five people, but the BS-12D is intended primarily for use in the flying crane rôle and has a "cutaway" between its cabin and main undercarriage in which external loads can be carried, under the C.G. First delivery, to Aero-Copters Aero-Boeing, was made in August, 1959.

PIASECKI MODEL 59K (VZ-8P)

—First flown on Oct. 12, 1958, this pioneer "flying jeep" quickly demonstrated that it was no mere ground-cushion rider by cruising 25 ft. above the ground during a demonstration to the U.S. Army five months later. In its original form it was powered by two

McDonnell Model 120.

180-b.h.p. Lycoming piston engines, but these were later replaced by a single Artouste IIB turbine, with which it flew for the first time on Jne. 28, 1959.

Development is to be continued with the improved four-seat Model PA-59H, with a more powerful Artouste IIC, which is expected to begin its flight trials in the near future under a further contract from the U.S. Army. In addition to having higher performance, the PA-59H is fitted with powered wheels, so that it can extend its range by using the roads.

ROTOR-CRAFT RH-1 PINWHEEL

—The latest weight and performance figures for this tiny one-man helicopter are even more remarkable than those published in the past. After some 300 flying hours, its maximum speed is now established as being 100 m.p.h. and it has a disposable load of over 335 lb., which is more than double its own empty weight of 165 lb.

Nearest thing yet to the strap-on helicopter of science fiction, it utilizes its pilot's legs as an undercarriage and is powered by two rotor-tip rockets which run on H.T.P. mono-propellent and give over 25 lb.s.t. for an "engine" weight of about 8 oz. each.

The production model, known as the Sky Hook, is designed to do even better, with an empty weight of 75 lb. and useful load of over 400 lb.

ROTORWING SPORTSMAN

—Another of the current crop of ultra-light autogyros flying in the United States, the two-seat Sportsman has an all-metal fuselage, although the rotor is of wood except for its steel spar. Instead of the usual modified target-drone engine, the prototype has an 85-b.h.p. Continental and is designated Model A1002-85. This version is stated to be in production, with deliveries to begin in February.

Later developments will include the Model A2002-180 Pelican on floats, the A3001-180 Grasshopper agricultural version and the military A3001-180M, all with 180-b.h.p. engine, larger rotor and increased fuel tankage. The prototype has been flying since April of this year.

RYAN MODEL 92 VERTIPLANE

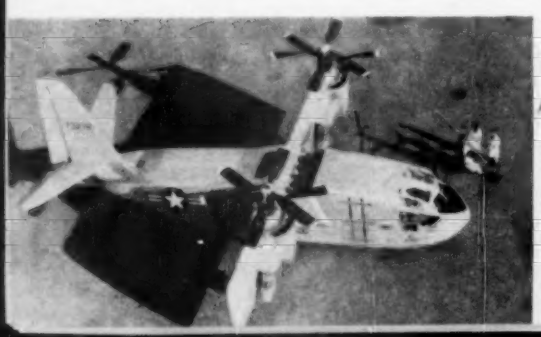
—Following its first flight early in 1959, the Vertiplane logged a highly successful six-week test programme. It made near-vertical take-offs at a ground speed of 25 m.p.h. after a run of only 10 yd., landed at 19.5 m.p.h., hovered at zero airspeed at heights ranging from 100 ft. to 3,700 ft. and made transitions from hovering to forward flight and vice versa.

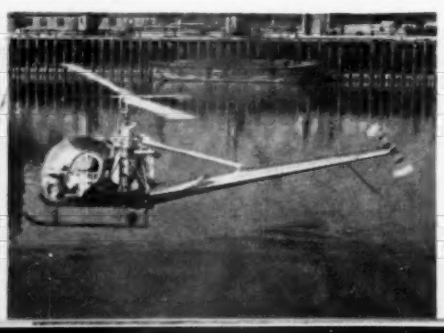
After delivery to NASA, it was all but written-off in an accident from which its pilot escaped by using his Martin-Baker ejection seat. Feeling, no doubt, that the test results were unusually promising for a deflected-slipstream aircraft, NASA are now rebuilding the Vertiplane with major assemblies supplied by Ryan.

SIKORSKY S-55

—A total of 1,278 S-55s have been built by Sikorsky, to which must be added the

Below, left to right: Hiller X-18, Hiller UH-12E, Hughes Model 269A, Piasecki Model 59K (VZ-8P) "flying jeep."





Above, left to right: Monte-Copter Model 15 Triphibian; Vertol HUP-4; Kaman HU2K-1 Seasprite; right, Sikorsky S-62.

Whirlwinds produced in England by Westland and others built by Mitsubishi in Japan.

The U.S. machines were delivered in two standard commercial versions, with Pratt & Whitney R-1340 engine, and 11 military versions, with R-1340 and Wright R-1300. These remain in service all over the World.

Standard accommodation is for a crew of two and 10 passengers or six stretchers, but S-55s have been used also for agricultural and flying crane duties. Sometimes they are operated on pontoons and one is flying in America with stub-wings as part of a research programme.

SIKORSKY S-56

—Production of the S-56 family came to an end in May, 1960, with delivery of the 154th aircraft, an H-37A Mojave for the U.S. Army. However, the big twins are still to be seen at Sikorsky's works, as the company is modernizing 30 early H-37s by fitting autostabilizers and other equipment.

The second major production version was the HR2S-1 transport for the U.S. Marines, a variant of which was the U.S. Navy's HR2S-1W with under-nose early warning radar scanner. The S-56 was the first helicopter to go into production with a retractable undercarriage.

Normal accommodation is for a crew of three and 20-23 passengers or 1,900 cu. ft. of cargo, loaded via the clamshell nose-doors.

SIKORSKY S-58

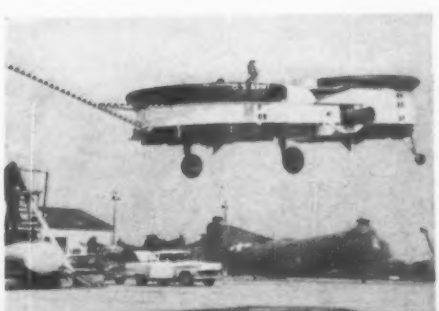
—The S-58 continues in production, with the latest $23 million orders for the Naval HSS-1N and Marine HUS-1 extending manufacture through 1961.

Well over 1,200 have been delivered, mainly to military customers; but the commercial versions form the basis of the helicopter fleets of Sabena and other airline operators. Twelve to 18 passengers can be carried by the standard transport models.

The U.S. Navy uses its HSS-1N for anti-submarine duties. The U.S. Army has fired rockets and machine-guns from its H-34A Choctaws, and the Marines have air-launched Bullpup from an HUS-1.

Sud-Aviation are producing a series of 150 in France and Westland's Wessex is, of course, a turbine-powered development of the S-58.

Above, Sikorsky HSS-2 anti-submarine helicopter.



SIKORSKY S-60

—This gawky-looking flying crane is likely to be the sire of a whole family of Sikorsky Skycranes. For many years Igor Sikorsky has stressed the value of the helicopter in this application.

Built around the engines and rotor system of the S-56, with a simple "backbone," tail unit and driver's cab in place of the usual fuselage, it has carried almost every conceivable type of load since its flight tests began on Mar. 25, 1959.

In addition to hauling cargo on the usual cables and platforms, and in nets, it has

Sikorsky S-64A Skycrane.

demonstrated the potential of the "pod" technique, carrying under its C.G. items such as a minesweeping pod built from the cabin of a Bell HSL-1 and a 20-passenger pod.

SIKORSKY S-61

—In its original form, the S-61 was intended to be a commercial counterpart of the HSS-2, with amphibious capabilities and the choice of two or three shaft-turbines. These features are still available, but indications are that the most popular version will be the S-61L, a non-amphibious transport for 25-28 passengers.

Suitable for all-weather operation, it is powered by two General Electric CT58-110 shaft-turbines and will enter service next year with Chicago Helicopter Airways and Los Angeles Airways, who have ordered six and five respectively. Other versions are the amphibious S-61A and S-61C freighter. First flight of the S-61 is imminent.

SIKORSKY HSS-2

—Largest amphibious helicopter yet flown, the HSS-2 is in production as the U.S. Navy's first combined anti-submarine hunter-killer. The prototype flew for the first time on Mar. 11, 1959, and has already shown tremendous advances over previous anti-submarine helicopters.

It has, for example, hovered continuously over one spot for more than three hours, performed four-hour simulated operational sorties and returned with adequate fuel reserves, and flown back 20 miles to base after an engine flame-out.

The first production model is scheduled to fly this month and the HSS-2 is expected to be joined on the assembly line by the HR3S-1 22-27-seat transport version for the Marines, with rear loading ramp.

SIKORSKY S-62

—The S-62 was the first of Sikorsky's new line of amphibious helicopters which, except for the HSS-2, have yet to meet with any major acceptance. The initial S-62A version, which flew on May 14, 1958, utilizes the well-proven rotor system and other major components of the S-55. The S-62B will use similar components of the S-58.

Apart from the amphibious hull, the major

attraction of the S-62A, compared with the S-55, is that the switch to turbine power gives a 350-lb. reduction in empty weight and an increase of 230 s.h.p., which makes possible an increase of 630 lb. in useful load, with full power up to 17,000 ft.

Seating 8-11 passengers, the S-62A has been delivered to Petroleum Helicopters, Los Angeles Airways and the I.A.F.

SIKORSKY S-64A SKYCRANE

—Now under construction, the S-64A is a much-refined development of the S-60, retaining the basic S-56 rotor system, but utilizing two of Pratt & Whitney's brand-new JTFD-12 shaft-turbines to give major increases in power and payload. Its maximum payload is approximately 16,000 lb.

If it proves a commercial success, Sikorsky plans to follow it with other Skycranes of gradually increasing size and capacity. The largest yet projected would be a 251,000-lb. aircraft, powered by four turbines and with a 12-blade rotor to haul a 40-ton payload 100 miles at 115 m.p.h.

UMBAUGH-18

—For the first time a rotorcraft manufacturer has "thought big," and Umbaugh have been promised the full co-operation of Lycoming, Hartzell and many equipment manufacturers in meeting their production target of up to 10,000 of their Model 18 aircraft a year.

This might seem impossible to achieve, but Umbaugh claim that they already have

Umbaugh Model 18.

deposits on some 6,000 of these little tandem two-seat autogyros and volume manufacture by Fairchild, under sub-contract, is well under way.

VANGUARD 2C OMNIPLANE

—There has been little news of this interesting convertiplane project since last year, but wind-tunnel tests are believed to be in progress at NASA's Ames Research Center.

The plan is for the Omniplane to take-off vertically with most of the engine power going into the ducted rotors and with the ducted propeller at the tail in low pitch. The propeller pitch will then be increased gradually to provide forward thrust.

When the wings develop adequate lift to maintain flight, the rotors will be declutched and the Omniplane will cruise as a conventional aeroplane.

International VTOL Survey . . . . TECHNICAL DATA

Aircraft	Powerplant			Fuel load	Total seats	Dimensions				Weights		Performance at max. A.U.W.					
	No.	Type	T.-o. power each			Rotor dia.	Fuselage length	Height o.a.	Disc area	Empty	Max. t.o.	Typical cruise		Initial climb	Service ceiling	Hovering ceiling*	Max. range
			s.h.p.	l. gal.		ft. in.	ft. in.	ft. in.	sq. ft.	lb.	lb.	m.p.h.	ft.	ft./min.	ft.	ft.	miles
BRAZIL																	
Baumgartl																	
PB 64	2	IPD M-60 Pulse-Jets	33 lb.s.t.	8.3	1	21 0	15 0	7 6	346	240	500	80 (max.)	1,000	N.A.	N.A.	N.A.	N.A.
IPD																	
Beija-Flor BF-1 (Humming Bird)	1	Continental E225	225	N.A.	2	29 6	27 8	10 4	683	N.A.	2,090	81	1,000	1,220	11,500	8,800	168
GREAT BRITAIN																	
Hawker																	
P.1127	1	Bristol Siddeley BS.53	*15,000* lb.s.t.	N.A.	1	24 4†	41 2	10 3	—	N.A.	N.A.	*M=0.9*	S/L	N.A.	N.A.	N.A.	*345+*
Short																	
S.C.1	5	Rolls-Royce RB.108	2,130 lb.s.t.	N.A.	1	23 6†	29 10	10 8	211.5‡	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Westland																	
Belvedere	2	Napier Gazelle 100 (NGa.2)	1,650 lb.s.t.	560	21	48 11	54 4	17 3	3,720	11,390	18,500	138	1,000	1,350	17,300	11,000	432
Rotodyne	2	Rolls-Royce Tyne	5,250	N.A.	75	104 0	64 6	23 2	8,490	35,564	53,500	*202*	5,000	—	—	—	*700*
Scout P.531-2 Mk. 1	1	Blackburn Nimbus	650	158	6	32 3	30 4	8 10	815	2,836	5,000	115	S/L	1,490	20,000	17,800	315
Skeeter	1	Blackburn Turmo 603	250	23	2	32 0	28 5	7 6	804	1,572	2,350	104	S/L	1,420	18,000	15,000	130
Wessex Srs. 1	1	Napier Gazelle 160 (NGa.13)	1,430	300	14	56 0	65 9½	15 10	2,460	7,600	12,600	115	S/L	1,750	14,200	7,000	390
Wessex Srs. 2	2	de Havilland Gnome H.1200	1,250	N.A.	18	56 0	65 9½	15 10	2,460	7,842	13,500	*132*	S/L	*1,500*	*20,000*	*10,000*	*345*
Whirlwind Srs. 2	1	Alvis Leonides Major	720	170	9	53 0	41 8½	13 3	2,206	5,375	8,000	99	S/L	1,080	15,700	9,400	335
Whirlwind HAR. 10	1	de Havilland Gnome H.1000	1,024	145	11	53 0	44 2	13 3	2,206	4,694	8,000	104	S/L	1,200	15,200	14,500	275
Widgeon	1	Alvis Leonides 521/2	500	83.2	5	49 2	40 10	13 2½	1,900	4,322	5,900	101	S/L	780	12,000	4,080	310
CANADA																	
Avian																	
2/180 Gyroplane	1	Lycoming O-360-A	180	26	2	30 0	15 2	8 9	706	1,090	2,200	*150*	S/L	*1,500*	*14,000*	—	400
CZECHOSLOVAKIA																	
HC-2 Heli-Baby	1	Praga DH	83	8.8	2	28 10	34 4	8 4	653	838	1,279	62	S/L	705	9,940	3,940	93
HC-3	1	M.108H	240	N.A.	5	*39 0*	32 9½	*10 9*	*1,134*	N.A.	3,086	100 (max.)	S/L	N.A.	N.A.	N.A.	N.A.
FRANCE																	
Helicop-Air																	
Girhel L51	1	Lycoming O-320	150	N.A.	2	32 9½	20 0	8 10	845.5	917	1,653	112	S/L	N.A.	N.A.	—	620
Sud-Aviation																	
S.E. 3130 Alouette II	1	Turboméca Artouste II	400	127.5	5	33 6	31 6	9 0	880	1,875	3,527	106	S/L	880	10,500	6,560	330
S.E. 3160 Alouette III	1	Turboméca Artouste IIIB	450	131	7	36 1	33 0½	9 8	1,022	2,300	4,630	112	S/L	N.A.	13,100	13,100	342
S.E. 3210 Frelon	3	Turmo IIIC	1,250	N.A.	28	49 2½	48 10½	15 5	1,902	11,025	22,050	*143*	S/L	N.A.	*12,460*	N.A.	*800*
S.O. 1221 Djinn	1	Turboméca Palouste IV	240 h.p.	55	2	36 1	17 4	8 5	1,022	794	1,765	66	S/L	690	10,000	3,000	118
GERMANY																	
Borgward																	
Kolibri I	1	Lycoming VO-435-AIB	260	39.6	3	30 10	27 3	10 0	753	1,765	2,645	*87*	S/L	*790*	*14,760*	*1,950*	*260*
ITALY																	
Agusta																	
AZ 101G	3	de Havilland Gnome H.1000	1,024	440	30	64 0	54 1	10 6	3,217	12,566	24,912	*125*	5,000	*1,280*	N.A.	*9,840*	310
Agusta-Bell Model 102	1	Pratt & Whitney R-1340	600	N.A.	10	47 7	41 9	10 7	1,780	3,990	6,280	100	600	1,100	14,000	9,500	220
Model A103	1	Agusta M.V. G.A.70	85	N.A.	1	24 3	20 1	7 4	462	617	1,014	84	S/L	787	N.A.	6,560	280
Model A104 Helicar	1	Agusta M.V. A.120	140	N.A.	2	26 1	20 10	7 7½	535	838	1,411	84	S/L	787	N.A.	9,840	205
Fiat																	
Model 7002	1	Fiat 4700	530	115	7	39 4	20 1	9 5½	1,214	1,433	3,087	*84*	S/L	N.A.	*11,150*	N.A.	*185*
Lualdi																	
L.59	1	Continental IO-470-D	260 e.h.p.	N.A.	4	34 9½	29 9½	9 10	951	1,631	2,645	86	S/L	820	19,355	9,515	300
JAPAN																	
Hagiwara																	
HCX-4	2	Ramjets	N.A.	N.A.	1	23 11	12 6	7 2½	452	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
NETHERLANDS																	
NHI																	
H-3 Kolibrie	2	NHI TJ5A Ramjets	51 lb.s.t.	88	2	32 8½	14 2½	9 0½	840	609	1,544	30-62	S/L	680	5,250	2,450	46
SOVIET UNION																	
Kamov																	
Ka-15	1	Ivchenko AI-14V	275	N.A.	2	32 8	—	—	840	—	—	*78*	S/L	—	*9,840*	*2,230*	*312*
Ka-18	1	Ivchenko AI-14V	275	39	4	32 8	23 0‡	11 0	840	2,255	2,888	68-75	1,600	—	11,500	—	250

Continued on page 781

* Hovering ceiling in ground effect. † Span. ‡ Wing area. Figures in italics are estimates or approximate.

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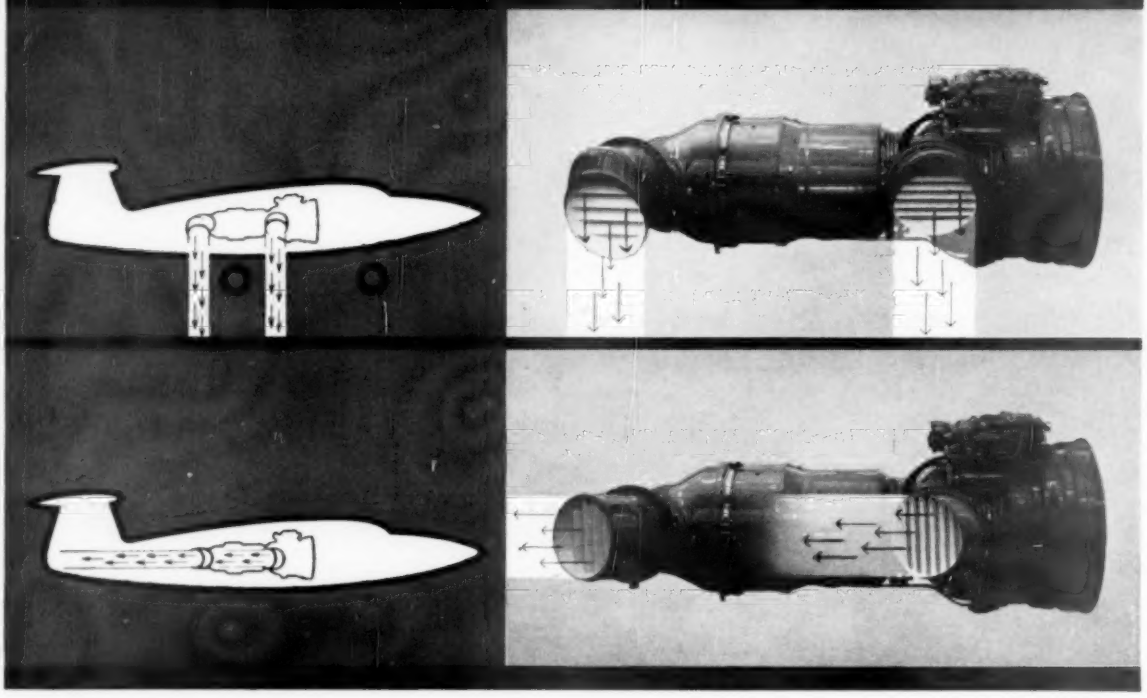

...ANOTHER ENGINEERING ADVANCE BY BRISTOL SIDDELEY

The new Bristol Siddeley BS 53 high-ratio turbofan represents a major engineering breakthrough in the field of aircraft propulsion. Because the BS 53 can be fitted with movable nozzles evenly disposed around the centre of gravity which give directional control to its total thrust, this remarkably versatile engine provides the airframe designer with a *single power source for all conditions of flight.*

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The Bristol Siddeley BS 53 has already been selected for the Hawker P 1127 VTOL light strike fighter and is supported by the Mutual Weapons Development Programme for NATO.

BRISTOL SIDDELEY ENGINES LIMITED

International VTOL Survey . . . .

Technical Data (Contd.)

Aircraft	Powerplant: No.	Powerplant: Type	Powerplant: T.-o. power each	Fuel load	Total seats	Dimensions: Rotor dia.	Dimensions: Fuselage length	Dimensions: Height o.a.	Dimensions: Disc area	Weights: Empty	Weights: Max. t.o.	Performance at max. A.U.W.: Typical cruise		Performance at max. A.U.W.: Initial climb	Performance at max. A.U.W.: Service ceiling	Performance at max. A.U.W.: Hovering ceiling*	Performance at max. A.U.W.: Max. range
Soviet Union—Contd.			s.h.p.	l. gal.		ft. in.	ft. in.	ft. in.	sq. ft.	lb.	lb.	m.p.h.	ft.	ft./min.	ft.	ft.	miles
Mil																	
Mi-1NKh	1	Ivchenko AI-26V	575	52.8	4	46 11	39 8	10 10	1,728	3,925	4,960	87	S/L	1,280	14,760	10,825	217
Mi-4	1	Shvetsov ASh-82V	1,700	N.A.	14	68 11	55 1	17 0	3,710	—	15,875	93	S/L	—	16,000	—	250
Mi-6	2	Soloviev TB-2BM	4,635	N.A.	120	114 10	108 0	N.A.	10,388	41,000	71,000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Yakovlev																	
Yak-24K	2	Shvetsov ASh-82V	1,700	N.A.	11	79 0 each	69 0	23 0	9,804	—	32,275	112 (max.)	S/L	N.A.	N.A.	N.A.	621
SPAIN																	
Aerotecnica																	
AC-12	1	Lycoming O-360-B2A	168	22	2	27 10	22 8	9 0	613.3	1,058	1,650	71.5	S/L	985	14,100	7,875	140
AC-14	1	Turboméca Artouste IIB	360	53.5	5	31 6	26 6	10 2	778.8	1,367	2,645	99	S/L	985	22,300	16,075	290
UNITED STATES OF AMERICA																	
Bell																	
Model 47G-3 Trooper	1	Franklin 6VS-335	225	34	3	37 3	28 6	9 3½	1,087	1,539	2,650	105	S/L	700	23,000	18,000	236
Model 47J-2 Ranger	1	Lycoming VO-540-B1B	240	40	4	37 1½	32 4½	9 3½	1,082	1,730	2,850	81	2,000	805	12,100	9,200	260
Model 204B (HU-1B)	1	Lycoming T53-L-9	1,100	104	10	44 0	—	14 7	1,520	4,318	8,500	126	6,000	2,600	N.A.	17,600	260
X-14	2	General Electric J85	2,500	N.A.	1	34 0†	25 0	8 0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
XV-3	1	Pratt & Whitney R-985	lb. s.t. 450	N.A.	1	23 0 each	30 3½	13 6	831	3,600	4,800	181 (max.)	5,000	N.A.	N.A.	N.A.	N.A.
Bensen																	
B-8N Gyro-Copter	1	McCulloch Model 4318E	72	5	1	20 0	11 4	6 3	314	247	500	60	S/L	2,000	16,500	—	300
Bensen B-9 Little Zipster	1	Mercury Mk. 78	70	N.A.	1	20 0	11 3	N.A.	314	450	700	60	S/L	900	11,000	6,000	100
Bensen B-10 Prop-Copter	1	McCulloch 4318E	72	N.A.	1	4 2 each	N.A.	N.A.	27.6	N.A.	650	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Brantly																	
Model B-2	1	Lycoming VO-360-A1A	180	26	2	23 8¾	21 9	6 11¾	442	980	1,600	90–95	S/L	1,580	N.A.	4,700	300
Capitol																	
Copter	1	McCulloch 4318E	72	8.3	1	23 0	11 6	6 9	415.5	390	690	*70*	S/L	*1,500*	*14,000*	—	*215*
Cessna																	
CH-1C Skyhook	1	Continental FSO-526-A	270	75	4	35 0	29 5	7 1½	960	2,080	3,100	90–120	1,000	1,030	N.A.	9,600	400
Chrysler																	
Aerial Jeep	1	Lycoming	380	N.A.	1	8 6	23 0	4 6	—	N.A.	2,000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Curtiss-Wright																	
VZ-7AP	1	Turboméca Artouste IIB	425	N.A.	1	—	17 0	N.A.	—	N.A.	*1,700*	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
De Lackner																	
DH-5 Aerocycle	1	Mercury Mk. 55	40	1.7	1	15 0	N.A.	N.A.	177	N.A.	500	75	N.A.	N.A.	N.A.	N.A.	50
Del Mar																	
DH-1 Whirlymite	1	Mercury	60	N.A.	1	16 0	15 7	N.A.	201	330	550	55	S/L	1,300	13,000	5,500	90
Doak																	
Model 16 (VZ-4DA)	1	Lycoming YT53	840	N.A.	2	25 6†	32 0	10 0	96‡	2,300	3,200	230 (max.)	S/L	4,000	N.A.	6,000	230
Doman																	
LZ-5-2	1	Lycoming SO-580-A1B	400	99	8	48 0	37 10	10 5	1,810	3,250	5,200	82	S/L	1,190	12,000	6,200	380
Gyrodyne																	
Model GCA-59 (YRON-1)	1	Porsche YO-95-6	72	N.A.	1	20 0	11 0½	8 0	247	536	910	77 (max.)	S/L	480	N.A.	N.A.	56
Model DSN-3	1	Boeing 502-10V	270	N.A.	None	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Hiller																	
H-23D Raven	1	Lycoming VO-435-23B	250	40	3	35 5	28 0	10 1½	984	1,816	2,700	82	S/L	1,050	13,200	5,200	205
Model 12E-4	1	Lycoming VO-540-A1B	305	40	4	35 5	N.A.	9 9½	984	1,760	2,750	88	S/L	1,340	14,600	9,550	225
Rotorcycle YROE-1	1	Nelson H-63B	43	—	1	18 6	—	6 11	268	300	556	49	S/L	920	12,000	2,600	166
Model X-18	2 1	Allison T40-A-14 Westinghouse J34	5,850 e.s.h.p. 3,400	N.A.	N.A.	16 1	63 0	24 7	405	N.A.	33,000	250 (max.)	10,000	N.A.	N.A.	N.A.	N.A.
Hughes																	
Model 269A	1	Lycoming O-360-C2B	lb. s.t. 180	21	2	25 0	22 3	7 11	491	867	1,550	85	S/L	1,450	11,000	6,000	300
Kaman																	
Model K-16B	2	General Electric T58-GE-2A	1,025	N.A.	2	14 10	39 7	N.A.	344	N.A.	8,900	*150*	1,000	*6,400*	*37,500*	*2,500*	—
HOK-1/H-43A	1	Pratt & Whitney R-1340-48	600	83	5	47 0	25 0	15 6½	3,470	4,040	6,800	75	S/L	1,300	18,000	12,000	220
H-43B Huskie	1	Lycoming T53-L-1A	720	165	12	47 0	25 0	15 6½	3,470	4,278	6,948	113	S/L	2,000	25,700	20,000	210
HU2K-1 Seasprite	1	General Electric T58-GE-6	1,025	N.A.	14	44 0	52 2	N.A.	1,520	5,050	9,150	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
McDonnell																	
Model 120	3	AiResearch GTC-85-35	85	176	1	31 0	20 0	9 0	755	2,450	6,300	106	1,000	1,400	N.A.	3,500	92
Monte-Copter																	
Model 15 Triphibian	1	Continental Model 141	200 e.h.p.	50	3	36 0	15 3	8 3	1,018	*1,232*	2,000	*75*	S/L	*1,100*	*15,000*	N.A.	*100*
Omega																	
Model BS-12D	2	Lycoming O-540-F1B5	260	33	5	39 0	36 0	13 0	1,194.6	3,350	4,750	85	S/L	1,200	12,000	6,200	N.A.

(Continued on page 782)

* Hovering ceiling in ground effect. † Span. ‡ Wing area. Figures in italics are estimates or approximate.

International VTOL Survey . . . .

Technical Data (Contd.)

Aircraft	Powerplant			Fuel load	Total seats	Dimensions				Weights		Performance at max. A.U.W.					
	No.	Type	T.-o. power each			Rotor dia.	Fuselage length	Height o.a.	Disc area	Empty	Max. t.o.	Typical cruise		Initial climb	Service ceiling	Hovering ceiling*	Max. range
U.S.A.—Contd.			s.h.p.	l. gal.		ft. in.	ft. in.	ft. in.	sq. ft.	lb.	lb.	m.p.h.	ft.	ft./min.	ft.	ft.	miles
Piasecki																	
Model 59K Sky Car	1	Turboméca Artouste IIB	425	N.A.	2	N.A.	26 1	6 8	N.A.	N.A.	2,350	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Rotor-Craft																	
RH-1 Pinwheel	2	Rotor-Craft R-1 rocket-motors	25 lb. s.t.	N.A.	1	17 0	7 0	8 6	227	165	500	80	S/L	2,000	N.A.	*15,000*	N.A.
Rotorwing																	
Sportsman	1	Continental C85	85	N.A.	2	27 6	12 0	7 7	594	750	1,200	*95*	S/L	*1,100*	*10,000*	N.A.	*350*
Sikorsky																	
HSS-2	2	General Electric T58-GE-8	1,250	N.A.	N.A.	62 0	54 9	15 4	3,019	N.A.	17,500	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
S-56	2	Pratt & Whitney R-2800	2,100	N.A.	25	72 0	64 3	22 0	4,070	20,831	31,000	115	S/L	910	8,700	4,500	145
S-58	1	Wright R-1820-84	1,525	165	20	56 0	46 9	15 11	2,460	7,630	13,000	98	S/L	1,100	9,500	4,900	182
S-60	2	Pratt & Whitney R-2800	2,100	N.A.	2	72 0	N.A.	N.A.	4,070	19,613	31,200	115	S/L	910	10,800	3,300	N.A.
S-61	2	General Electric CT58-110	1,250	N.A.	28	62 0	54 9	15 4	3,019	10,259	18,700	145	S/L	1,640	9,500	5,000	285
S-62A	1	General Electric T58-GE-6	1,050	N.A.	13	53 0	44 7	14 2	2,206	4,616	7,500	115	S/L	1,380	15,700	12,000	N.A.
S-64A Skycrane	2	Pratt & Whitney JF-TD-12	4,050	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Umbaugh																	
Model 88	1	Lycoming	180	25	2	35 0	21 0	9 3	960	1,200	1,800	100	S/L	1,050	15,000	N.A.	350
Vertol (Boeing)																	
Model 107-II	2	General Electric CT58-110	1,250	N.A.	27	50 0	44 7	16 10	3,990	10,425	18,450	148	5,000	1,700	13,700	7,800	230
YHC-1B Chinook	2	Lycoming YT55-L-5	1,940	N.A.	34	57 0	51 0	18 6½	5,104	N.A.	33,000	144	S/L	1,570	7,100	1,900	1,160
Model 44	1	Wright Cyclone 977C9 HD1	1,425	250	—	44 0	52 6	15 5	3,040	8,990	15,000	101	S/L	1,050	N.A.	5,400	280
VZ-2	1	Lycoming T53-L-1	860	N.A.	2	9 6	26 5	N.A.	141.8	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

* Hovering ceiling in ground effect. † Span. ‡ Wing area. Figures in italics are estimates or approximate.

Above, left to right, the Agusta AZ-101G, the Vertol Model 107-II prototype and a model of the Westland 194.

Left, an impression of the Sikorsky S-61L.

Right, the Eland-powered prototype of the Westland Rotodyne.

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Aviation News in General

SINGAPORE DEFENCE. — The C.-in-C., Far East Air Force, Air Marshal A. D. Selway, has stated that ground-to-air missiles, probably either Bloodhounds or Thunderbirds, are to be sent to Singapore to help strengthen the island's defences. F.E.A.F. fighter squadrons are also to be re-equipped with Hunters and Javelins, but Bomber Command V-bombers are not to be stationed permanently in the Far East.

AUSTRALIAN AVIATION.—A new Australian Army flying unit—No. 16 Army Light Aircraft Squadron—was formed last week. Operating Bell helicopters and Cessnas, the Squadron has R.A.A.F. ground crews, Army pilots and observers, and some R.A.N. flying instructors. It is commanded by Wg. Cdr. K. Robertson, R.A.A.F.

S.A.A.F. ALOUETTES.—The first four of an unspecified number of Alouette 2s ordered by the South African Air Force have arrived at Waterkloof air base from France. The S.A.A.F. helicopter squadron is to be expanded as part of the South African Government's decision to reorganize the country's defence forces.

CLOSING U.S.A.F. BASES.—Three U.S.A.F. bases are to be closed because of the transition from aircraft to a mixed force of missiles and manned weapons. These bases — Mitchel, MacDill and Chennault—are the first to be closed for this reason.

RUSSIAN RECORD. — Soviet test pilot Konstantin Kokkinaki, presumably a relative of the veteran Vladimir Kokkinaki, Ilyushin chief test pilot, has claimed a new 100-km. closed-circuit record of 2,148.3 km./hr., or nearly 1,335 m.p.h. He was flying a single-engined single-seat E-66 research delta at about 44,300 ft., and achieved M=2+ during the half-hour flight. Curiously, the new Russian figure is less than the 1,390 m.p.h. set up by the McDonnell F4H on Sept. 25.

CESSNA TWINS.—Three new light twins are to be offered by Cessna in 1962-63. First is the Model 320, a 240 m.p.h.-cruise five-seat development of the 310F, with turbo-supercharged and fuel-injected engines, to be followed by the four-seat Model 336. This is the tractor-pusher twin-boom design we mentioned a week or so ago, and is a high-wing fixed-nosewheel type similar in some details to the Cessna 182. Third twin is the 6-10-seat Model 410, which will be in the 250-m.p.h. 8,000-lb. category.

INDIAN S-62B.—Last week Gp. Capt. H. S. Ratnagar (2nd right), Air Attaché at the Indian Embassy in Washington, accepted delivery of a Sikorsky S-62B for the Indian Air Force. Built especially for high altitude operations in the Himalayan Mountains, this S-62 is equipped with four rotor blades, instead of the usual three, and is expected to lift a 1-ton payload to 20,000 ft.

DEBRIS ON CUBA.—A cow was reported killed in Eastern Cuba by a fragment of a Thor/Able Star rocket which went out of control during a launching at Cape Canaveral on Nov. 30. The rocket, which was intended to launch a new Transit navigational satellite and a smaller research satellite, was blown up by the range safety officer.

SHORT BRITANNIAS.—The last Britannia to be built by Short Brothers and Harland was delivered to R.A.F. Transport Command on Dec. 2. Altogether, 30 Britannias have been built at the company's Queen's Island factory; 18 of these were for the R.A.F. and the remainder were supplied to civil operators. In addition to complete aircraft, Shorts also built major components for five Britannias assembled at Bristol and converted two for B.O.A.C.

S.L.A.E. RECONSTITUTION.—The general council of the Society of Licensed Aircraft Engineers has published its provisional proposals for the reconstitution of the Society. These will be discussed at two meetings to be held during 1961 and a postal ballot will be conducted later in the year with the object of bringing the new constitution into force on Apr. 1, 1962.

GETOL CONTRACT.—Vertol has received a contract from the U.S. Army for a design study of a ground-effect take-off and landing (GETOL) vehicle. It will have wings for normal flight but will use ground-effect techniques during take-off and landing.

BOMARC B.—First production Boeing IM-99B has been rolled out at Seattle. In tests Bomarc Bs have made seven successful interceptions of supersonic Regulus missiles and jet drone aircraft.

SCOUT FAILS.—First attempt to orbit a research payload with the all-solid, four-stage, Chance Vought Scout has failed. Launched from Wallops Island, Virginia, on Dec. 4, the rocket's second stage did not ignite. Payload was a 12-ft. dia. inflatable "balloon" intended for drag measurements in the upper atmosphere.

TITAN BLAST.—Explosion of a two-stage Titan ICBM during fuelling operations 165 ft. below ground in the "hardened" launching site at Vandenberg A.F.B., California, was reported on Dec. 3. Heavy damage resulted.

SWISS DRAKENS?—For the second time a Saab 35 Draken is to be assessed in Switzerland. The version offered is the Saab 35H (H=Helvetia), a combined fighter, attack and reconnaissance version powered by a Rolls-Royce Avon RB.146, with a Swedish afterburner, giving 49,000 ft./min. rate of climb at ground level.

CARRIER TRIALS.—Two Blackburn Buccaneers have recently completed deck landing trials on H.M.S. "Ark Royal" operating in the Mediterranean. Flown by Blackburn and Boscombe Down pilots, the aircraft made over 60 landings on the carrier.

Commercial Aviation Affairs

PROBLEM AT MANCHESTER.—Since B.O.A.C. started Boeing 707 services through Manchester, on Oct. 16, 20 of the 49 scheduled flights have been unable to land there. New arrangements have now been made to handle intending passengers when the aircraft is forced to overfly Manchester, using chartered aircraft or cars to take them to Prestwick or London, or from Prestwick to Manchester in the case of inbound passengers. The problem at Manchester arises from a combination of poor drainage on the runway, a downhill slope and absence of ILS for approaches into the prevailing wind, and a frequent cross-wind component.

HERALD NEWS.—Handley Page has adopted Series 100 and Series 200 designations respectively to identify the standard and long-fuselage Heralds. Individual airline models will have different type numbers in the appropriate Series; Jersey Airlines' six examples are Herald 201s. Prospective Herald customers are North-South Airlines, which hopes to take delivery of one next spring, and Air Safaris, which, as reported last week, has recently acquired the air transport business of Don Everall and the fleet and assets of Falcon Airways.

COMET ORDERS. — The recent B.E.A. order for four more Comet 4Bs brings the total on order for the Corporation to 14, in addition to four of the same type purchased by Olympic Airways. A total of 60 Comet 4 series has now been ordered, and options on additional aircraft are held by United Arab Airlines (2) and Middle East Airlines (1). The third and last Comet 4C for Mexicana left Hatfield on its delivery flight on Nov. 29.

NORTHEAST CONVAIRS.—Howard Hughes has agreed to release six of his Convair 880s (originally ordered for T.W.A.) for lease by General Dynamics to Northeast Airlines. Equipped as 97-seaters (including 65 coach-class) they will go into service on Dec. 15 between Philadelphia and Miami. This arrangement was part of the agreement between T.W.A. and Northeast which may eventually lead to a merger between the two airlines. In place of the 880s, Hughes is reported to be considering purchase of six Convair 990s.

FIRST AND LAST.—After a useful flying life of over eight years, the original Bristol Britannia G-ALBO was retired on Nov. 30, when it flew from Filton to R.A.F. St. Athan, Glamorgan. There it will be used for ground instruction of R.A.F. trade apprentices.

RADIO-RANGE TRIALS. — The F.A.A. and U.S. Coast Guard began trials on Nov. 23 of a radio-range installation on the Coast Guard cutter "Androscoggin" at Ocean Station Charlie. The trials are aimed at developing a usable VORTAC facility on an unstable base.

GHANA INAUGURATION.—Ghana Airways inaugurated on Dec. 2 a twice-weekly service between London and Accra using its own Britannias with 28 first-class and 42 tourist-class seats. The aircraft are flown by B.O.A.C. crews and the cabin crews include two Ghanaian stewardesses. A new office at 8 New Bond Street was opened by Ghana Airways on Dec. 5.

BERLIN STUDY.—The three Western Powers in Berlin have asked the F.A.A. to make an immediate simulation study of the terminal air traffic in Berlin. The study will be made on a dynamic A.T.C. simulator at NAFEC, and is intended to help solve current problems inherent in the three corridors leading in and out of Berlin.

OCTOBER TRAFFIC. — The provisional M.o.A. figures for U.K. airlines' traffic on scheduled and inclusive tour services in October show an increase of 19% to 42 million short ton miles. Capacity operated increased by 23% and the overall load factor fell from 61% to 60%.

BRUSSELS—MEXICO.—On Dec. 2 Sabena inaugurated its twice-weekly service between Brussels and Mexico City, via Montreal.

IRISH RECORDS.—The first of three Boeing 720-048s ordered by Irish International Airlines was delivered in Dublin on Nov. 18, after flying from New York to Shannon in the record time of 4 hr. 57 min. Before delivery it was used for crew training at Tucson, Arizona, averaging 12 hr. a day for 18 days to train 14 pilots.

RONALDSWAY RECORDER.—On Dec. 9 one of Thermionic Products new Series 3 multi-channel A.T.C. recorders was due to be installed at Ronaldsway Airport, Isle of Man.

ILLEGAL CHARTERS. — A DC-4, registered in the name of International Material Supply Corporation, of Palm Beach, Florida, was seized in New York recently at request of the F.A.A. for alleged violation of the Civil Air Regulations. According to the F.A.A., I.M.S.C. used the aircraft to carry 288 passengers from New York to London in July and August without a commercial operator certificate. The maximum civil penalty for the offence is $288,000.

AIR CARGO GUIDE.—The London Chamber of Commerce has issued a booklet on air freight which is intended as a basic guide for those who have not previously made use of air transport and as a reference handbook for the more experienced. It outlines the air-freighting system and gives lists of specialized authorities. The booklet (2s. 6d. post free) is obtainable from Chamber of Commerce Publications, 68 Queen Street, London, E.C.4.

WRECKAGE FOUND.—The wreckage of the Philippine Air Lines DC-3 which crashed on a flight from Iloilo to Manila was found on Mount Baco about 90 miles south-east of Manila. There were no survivors.

News About People

WEYBRIDGE NEWS. — Vickers-Armstrongs (Aircraft), Ltd., have announced that Mr. E. Smyth, deputy chief designer (weapons), has been appointed sales manager (guided weapons). Mr. F. H. J. Denning, progress manager since 1955, has taken over the company's newly created post of production manager—spares.

S.I.M.A. NUCLEONICS GROUP.—Mr. E. B. Thompson, sales manager, Ekco Electronics, Ltd., has been elected chairman of the Nucleonics Group of the Scientific Instrument Manufacturers' Association.

HUNTING CHANGES.—Mr. W. D. Corse is retiring as managing director of Aircraft Operating Co. (Aerial Surveys), Ltd., on Dec. 31, but will remain on the board. Mr. E. J. D. Pritchard has been appointed managing director of this company and Field Aircraft Services, Africa, Ltd. Mr. J. L. Boon is to succeed Mr. Pritchard as managing director of Field Aircraft Services (Rhodesia) (Pvt.), Ltd., and Mr. P. H. O'Brien has been appointed to the company's board. Mr. S. H. Evans is to become a full director of Field Aircraft Services, Africa, Ltd. All these appointments take effect on Jan. 1, 1961.

WELDING RESEARCH.—Mr. E. V. Beatson of Joseph Lucas, Ltd., has been appointed by the Council of British Welding Research Association to serve on the Association's Research Board.

CANADAIR CHANGES. — Four senior appointments have been announced by Canadair, Ltd. Mr. F. R. Kearns has become executive vice-president for sales and finance; Mr. J. Urwin has been appointed vice-president and secretary; Mr. J. B. Hunter has become comptroller, and Mr. T. C. Pawlett has been appointed treasurer.

AVRO VISITOR.—Earlier this month Chief S. L. Edu, director of Nigeria Airways, visited Avro's and is seen listening to a presentation on the 748 from Mr. K. Edgerton, the company's chief performance engineer (left), and Mr. E. Galitzine, sales manager.

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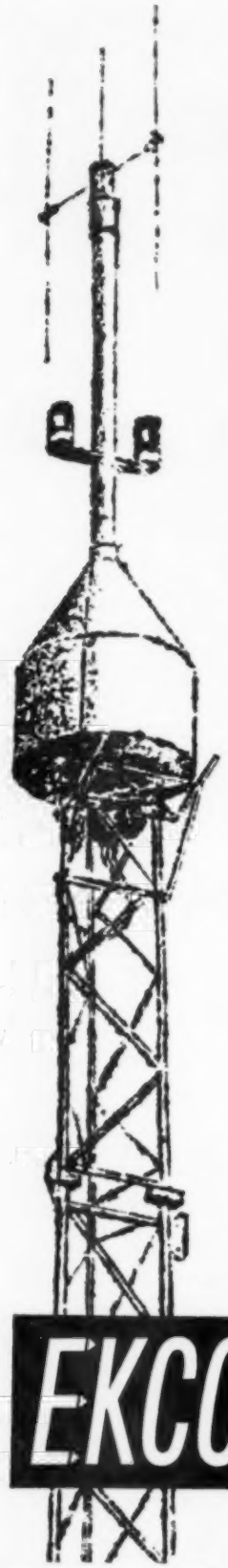

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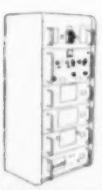

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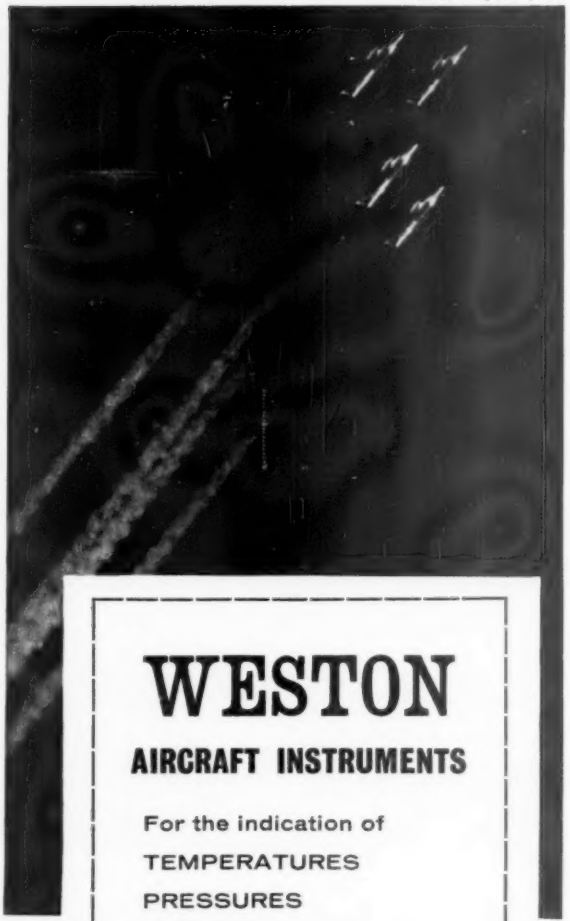

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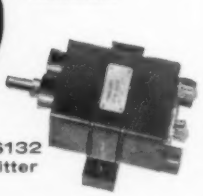

*Model S132 Transmitter

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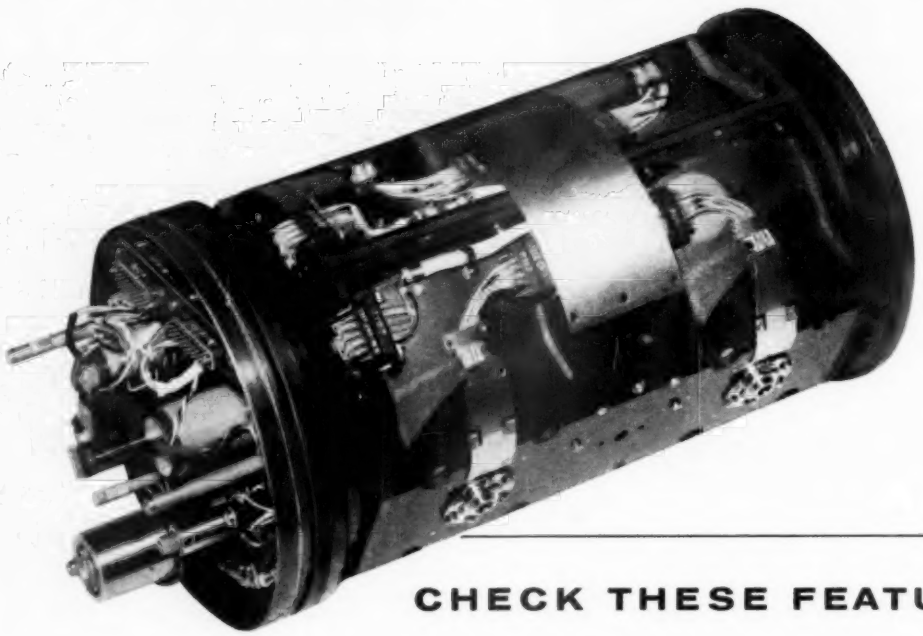

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Personal Flying

C.-in-C.'s Tribute to Flying Clubs

RARELY has a member of the Air Council paid so warm a public tribute to the flying clubs as did Air Marshal Sir Hugh Constantine, A.O.C.-in-C. Flying Training Command, at the Association of British Aero Clubs' annual dinner on Nov. 30.

Of the 3,012 boys who had received the Association's flying scholarship awards since the scheme had started in 1950, 1,150 had, he said, joined the R.A.F. as aircrew, and 254 as ground officers. Also, the "wastage"—that is the elimination of unsuitable applicants and trainees—was markedly lower with these club-trained young men than it was among aircrew applicants from other sources—about 16% compared with 95%. The R.A.F. needed 50% more pilots and navigators.

Sir Hugh also told us that the Treasury was concerned with the cost of our 17 Chipmunk-equipped University Air Squadrons, whose members number 860 at the moment. The closing down, if it came, would be a loss to the Service, the aircraft industry and the clubs, to which a substantial number of squadron members turn after leaving their universities.

Another problem facing the R.A.F. was the shrinking air-space available for flying training—23% of the country's air-space was now controlled. Long-established and well-equipped stations in the Command are likely to have to close down and transfer their activities to Scotland and South West England.

Increasing control of flying space, though inevitable, was taking a lot of the fun out of flying. A small consolation, indicative of the Service's growing regard for the private flyer was that the latter did not now need Air Ministry permission to land on an R.A.F. airfield—only the Station Commander's.

SIR LIONEL HEALD, Q.C., A.B.A.C. vice-president, presented statistics which showed that while the national private flying situation was improving, we are still lagging behind other countries. The aviation petrol tax remission was worth about £60,000 annually to the clubs. France subsidizes its private flying to the tune of £300,000, Italy's subsidy was £130,000, Australia £150,000, New Zealand, with less than four million inhabitants, £45,000.

France had 14,000 private pilots, 400 clubs and 2,500 private aircraft. Since 1950 U.K. clubs had risen from 59 to 126, flying hours from 37,000 to 95,000. We had only 29 clubs sponsored by firms, a figure which he urged should be improved. We should produce more light aircraft and create the demand for them.

The Treasury constantly had their eye on the petrol tax remission. If it were rescinded fewer people could afford to fly, utilization would go down, costs would in consequence increase and the numbers of flyers be reduced. It could start the slippery slope back to 1950.

The Lennox Boyd Trophy for the year's most efficient club was awarded to the Northamptonshire Aero Club and accepted on their behalf by Mr. L. C. Hilditch. Oxford were runners-up, then came Exeter, Elstree, Cumberland and Southend, in that order.—WREN.

* * *

Talks between representatives of the Jersey States, the Island Parliament, and the Channel Islands Aero Club are taking place on the possibility of the club purchasing an American Lake LA-4 amphibian for use in air-sea rescue. The club is prepared to spend £11,000 on the purchase of the four-seat aircraft if the States will undertake to make a grant sufficient to cover part of the operating costs.

Jersey Airport, the second busiest in the British Isles, has at present no air-sea rescue arrangements other than those provided by lifeboat and similar services. The nearest helicopter station is at Portland, 90 minutes away. Under the scheme now being discussed, the aircraft would be held in readiness at the airport. It would be manned by members of club, aided by volunteer airline pilots.

It would carry self-inflating life rafts for 60 people and provide assistance for 20 others. It would take 5-15 minutes to reach any point round the island's coast.

Gliding Notes

by Dr. A. E. Slater

WHERE will the 1962 World Gliding Championships be held? The F.A.I. Gliding Commission has just had a meeting at which it was hoped to decide which of the various offers to accept. But there were no offers to decide upon. One had been expected from Argentina, who had once before offered to organize the Championships, but the Argentine delegation failed to turn up.

There was much discussion on whether an offer from across the Atlantic, either from Argentina or the United States, should be accepted at all, as too few countries might be able to afford to send teams. An earlier Argentine suggestion had been to send a ship to fetch all the European teams and their gliders; but not many pilots or crews could have spared the time for a two-way sea voyage in addition to the Championships period.

A few years ago the Gliding Commission decided to hold the World Championships every three years, but it soon reversed the decision and returned to the two-year period. But circumstances may dictate otherwise. The way the World is going, there may come a time when the Championships have to be held in each of the five Continents in turn. Anyway, the Gliding Commission is meeting again next April, by which time it is hoped some European country may make an offer.

* * *

HEADLINE was "The Sheriff Glides into the Lock-up" in one of the many papers which reported the latest cross-country by Alfred Warminger from Swanton Morley in Norfolk. He flew 58 miles westward to R.A.F. Wittering, where they put him in the guard room, doubting his story that he was Sheriff of Norwich. Was this because he did not arrive riding a horse but a glider? He stayed under guard till his retrieving team arrived.

Soaring conditions were good, considering it was only a week short of December; Warminger says he reached 8,000 ft. and was never below 4,000 ft. till the end. According to the weather chart, he flew against a west wind of force 2; the air was following an occlusion, and had come across the Atlantic from the latitude of New York, instead of from near the Arctic Circle, as is more usual with soarable air in the cold half of the year.

A little time ago an overseas newspaper (let us not say when or where) published a report from England of a cross-country glider flight which ended at a still more secret aerodrome—so secret that the pilot was made to promise not to reveal where he had landed. The report gave the starting-point, the distance and the date, so it was only necessary to look up the wind direction for the day, convert the miles into versts, and you had the answer.

* * *

IN one day 16 height Diamonds (16,404 ft.) were earned at Innsbruck, presumably in waves; Dr. Max Schuh and Ernst Schrafft put up an Austrian two-seater distance record with 187 miles from Innsbruck to Graz in an Mg-19; and Dr. Anneliese Schuh-Proxauf put up a women's national altitude record with 19,700 ft. gain of height.

Another Austrian pilot, Fritz Pachowsky, describes in *Austroflug* a visit to St. Auban. In 3½ weeks he had 22 flights totalling 45 hours, was introduced to six new sailplane types, and qualified for Gold "C" and Diamond altitude with 19,360 ft. gain of height, reaching 22,300 ft. a.s.l.

SELF-LAUNCHER.—A rear view of the Fauvel AV-45 sailplane which M. Fauvel states can take off in 100 yards and climb at 600 ft./min. on its completely enclosed two-stroke engine (see this page last week).

Leo White discusses—

What New Zealand Wants

LOOKED at from afar and statistically, in size about 1,000 miles long and a little over 200 miles at its widest part, and with a population of almost 2½ million, New Zealand would appear to be a small market for light aircraft. In reality it is a juicy one but any thoughts of a British onslaught on this market has dwindled with the passing of the years. Whether the new Masefield-Miles-Auster set-up will raise any more than the odd eyebrow remains fair and square on their plate.

After the War it looked as if Auster had this market in the palm of their hand but at the moment the American light types are running proverbial rings around them. Australia has come to light and the new Victa organization has just had the pleasure of introducing its prospective wares to New Zealand with a provisional order from the Auckland Aero Club to the tune of nearly £50,000. Chicken feed perhaps, in overall British terms when sales in millions are frequently quoted by the S.B.A.C. but maybe it is this factor that has made it so hard for any manufacturer of small types.

New Zealand, when looked at in the light of true executive requirements, does not appear to rate as a potential, when compared with other countries which have huge populations and vast supporting industries. New Zealand is generally hilly to mountainous with small coastal plains and is surrounded by lonely oceans with Australia and its larger centres of poulation and near-considerable commercial business over 1,200 miles away. Yet for all that, New Zealand is one of the most versatile users of light aircraft, particularly in connection with agricultural pursuits.

Aero clubs thrive, with some of their fleet being used for semi-executive work. Where they are hired by firms and staff, qualified pilots take their "bosses" on flights which are often a combination of business and pleasure. The regular air traveller relies mostly on the scheduled air services, hires a rental car for his end-of-journey ground transportation and so works his business economically. Airport facilities have not expanded sufficiently with commercial amenities to attract large numbers of executive aircraft business fliers and as the major airports get busier, so are the smaller fry being squeezed out. Nevertheless, with thousands of farm airstrips and a growing number of provincial aero club activities and of private owners there are healthy signs of the growing use of four-place aircraft.

The question can now be asked whether Britain, after having the ball at its toe, can regain a market which has been virtually given away over the past 10 years. The country owes much to the de Havilland family for in the late 'twenties and all through the 'thirties it was a de Havilland world. With the ubiquitous Moth range, together with odd Avian, Spartan and Miles examples, foundations were laid which few ever thought would die. While the famous Tiger flew around in droves after World War II and showed the way to the huge aerial top-dressing industry of today, it is now Piper, Cessna, Fletcher, Lodestar and DC-3 aircraft which drop over 500,000 tons of fertilizer annually.

How far British light aircraft have receded in local popularity can be gauged from the fact that there are now only a little over 60 Austers on the register. They started selling in the mid-1940s, while it is in recent years only (with the lifting of import restrictions) that Cessna and Piper have come in any quantity. There are now about 100 of the former and 140 of the latter. They are still in demand.

In 1947 the late Nicholas Higgs of British Aircraft, Ltd., handed over an Auster with a Cirrus Minor to Doug. (Grata) Grieg, an enthusiastic flier and an ex-Pacific war pilot for his use and to take Tom Ewart, then editor of *Whites Aviation*, and myself around the country to show the flag. We did and we were proud of the little job, dropping in on the outskirts of towns, on back country paddocks and in good, bad and indifferent flying conditions. Old timers and youngsters were equally intrigued at what seemed a docile and friendly little machine and many civic leaders were even given a treat. It received enthusiastic Press treatment. Aero clubs went for it and so did early aerial work operators but there it has remained in the minds of many an early starter after the War but which got very little farther. Auster regretfully did not move with the times. Spares were often short and costly and then it suffered some adverse publicity in accidents. The Agricola never came to anything.

A large number of second-hand Austers came into New Zealand as did Proctors and reconditioned engines but, looked at from a British prestige point of view, it was really a poor long-term investment, for it tended to emphasize that Britain had very little new nor was it interested,

When the "floosied"-up American types came along, many took the point of view that anything British belonged to the old "helmet and goggles" age. Self-starters in anything British appeared to be considered a luxury. There were memories of restive minutes, while one pulled the prop. and all the old routine of switches, on and off, suck in, well try again—petrol in the tank slopping from one side to the other and at last, after many damns and blasts, at least a sweet-running engine.

In our new world of colour and sleekness in the 1950s there was the continued atmosphere of austerity in the Auster, as against the new bright Pipers and Cessnas. These looked good, comfortable, glossy, wall-to-wall carpet like, with chrome knick-knacks with a push-button atmosphere that made one feel extra good and your friends were glad to be with you.

The British motor industry took a long while to learn about New Zealand requirements and despite our size this is still a worthwhile market. We are no longer that old-time atlas description, the "Antipodes" . . . we've never been able to discover why anyone uses that phrase now, nor are we the colonies. Tradition and stubbornness die hard and neither can be eaten or pay the rent, nor do they attract customers for certain types of aeroplanes.

It is quite obvious that it is no longer any use building even an aeroplane with the idea that one must take it and be damned. It will have to be good . . . it will have to be competitive and, here anyhow, if it is not right it will suffer an early fate and more than that, might not even get to the starting barrier in this country. There will also be the necessity of standing behind and backing up one's agents or representatives.

Good luck to BEAGLE and may it come up with the answers in the same way as do Britain's magnificent jets and turbo props! I, for one, hope so.

AS IT WAS.—In 1947 an Auster was flown all over New Zealand by Doug. Grieg, of Auckland (centre) with Tom Ewart (then editor *Whites Aviation*) and Leo White (right). It set a new standard for small aircraft. Times have changed and British light aircraft have lost the advantage they had. The small people in the picture, if they are flying themselves today or are interested, are more likely to be using or admiring American light aircraft.

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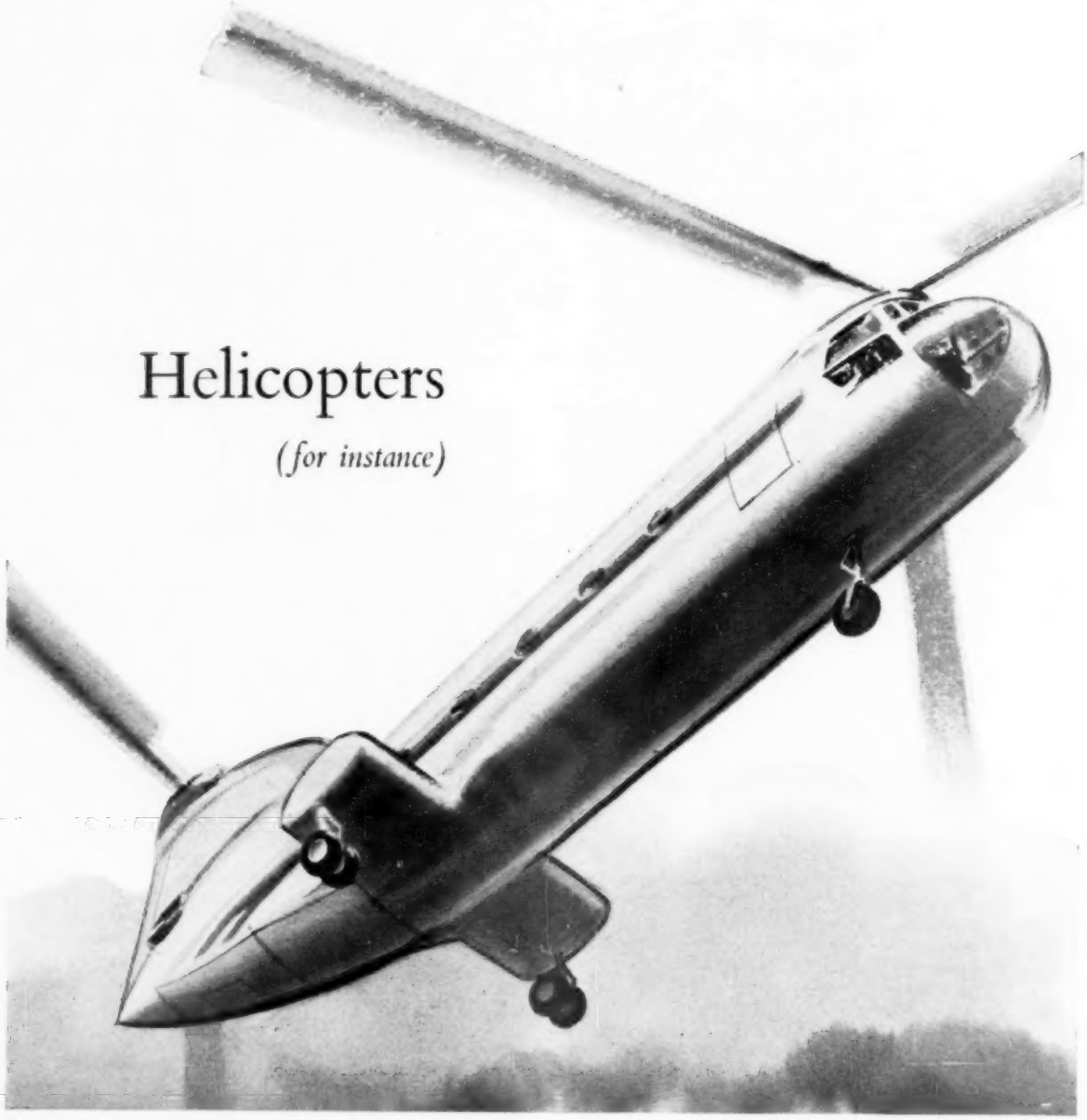

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Correspondence

Imperials' Early Days

IN the most generous review of my book which appeared in your issue of Nov. 4, which has just come to hand, there are certain statements which I feel should be clarified.

My university* put up something less than £50 for typing while Shell put no money into publication, but did kindly arrange the contact with Foulis. It might also be relevant to mention in my education some three and a half years spent in the R.A.F., part of which was in Transport Command.

The suggestion was made that Mr. Woods-Humphery may have exerted an undue influence. That is not so. I attempted as much as was possible to check all his statements against documentary evidence, and failing that to obtain corroboration or denial from other principals. A good historian will always doubt his sources until he is reasonably sure that internal and external evidence has proved their validity. I have tried to follow that precept; I hope successfully.

I appreciate Mr. Brooks' suggestions and thoughts. I hope they will stimulate more research into those facets of the picture which space forbade me to cover.

Chapel Hill, N.C., U.S.A. ROBIN D. S. HIGHAM, Ph.D.

* The University of North Carolina.

One Viewer's Reaction

WHAT a great disservice to civil aviation it was to devote time in "Panorama" recently to the relative merits of JP 1 and JP 4 jet fuel.

Very rightly, this subject has been receiving attention in the aviation Press; but surely nothing but harm can come to the industry as a whole by an argument which commences: "When an airliner crashes"! It was unfortunate that Lord Brabazon's claims were not answered by fuel technologists—and even more unfortunate that millions of viewers were led to associate sheets of flame with day-to-day air travel.

When we consider that today the bulk of the World's airline passengers still fly aboard piston-engined planes using petroleum—the most inflammable of all fuels—nothing can be said for creating a situation which appears calculated to undermine the public's confidence in the safety of civil flying.

London, W.1. PETER COLBOURNE.

The State of the Status

I SHARE the mild disgruntlement expressed here on Nov. 25 by "Cap" Capper, Scottish Aviation's flight manager and chief test pilot, when he wrote of airlines announcing propeller-turbine aircraft as "jets." It is, of course, a sales and publicity gimmick designed to make the less-knowledgeable passenger feel a bit superior to those travelling in corny old piston jobs and of equal status to the "real" jet passenger.

"Cap" would find life almost intolerable in Australia where T.A.A.'s Electras, Viscounts and Friendships are called a "Jet Fleet." The most egomanic passenger announcement I've heard is Qantas' call for their "Round-the-World Jet-Flight" customers. After all, it's the ultimate status-boost, until the supersonics arrive—or the dreaded final call: "Interplanetary Spaceways' Round-the-Universe Service is now ready for departure. . . ."

Worcester Park, Surrey. E. A. CHRIS WREN.

The Leisurely Trunk Routes

THE artful aid of alliteration in the final phrase of the first paragraph, editorial Oct. 21, raises nostalgic memories of the leisurely Trunk Routes of yesteryear, though perhaps not with quite the same connotation.

Johannesburg, S. Africa. "IMPERIAL WEBFOOT."

No Toys are Kites

HEIGHTS of 1,000 metres reached by man-carrying kites are quoted by F.H.S. on Nov. 25 last. Meteorological kites, even in the 19th century, were going many times as high. A. Lawrence Rotch, in his book "Sounding the Ocean of the Air," published in 1900, mentions a height of 11,440 ft. above Blue Hill Observatory in Massachusetts, or 12,070 ft. a.s.l., reached by the uppermost of a train of four box-type kites on Aug. 26, 1898.

He used five miles of steel piano wire, 0.032 in. thick, weighing 15 lb. per mile. The lifting surface of the top kite was 71 sq. ft., and that of the other three together 78 sq. ft.; the total weight of the kites and apparatus was 112 lb. Wind velocity was 22 m.p.h. on the ground, 40 m.p.h. at maximum height. Launch was at 10.40 hr., maximum height at 16.15, and landing at 20.40.

Rotch's conclusion from a large number of such experiments was: "While it appears certain that no navigable balloon or flying machine will ever be able to stem the enormous velocity of the upper atmosphere, rarefied though it is, perhaps in the future aerial machines will take advantage of the prevailing currents of the high atmosphere, as our sailing ships do of the trade winds."

Whipsnade, Beds. A. E. SLATER.

Groundabout

M.P.F. Triumphant. For those of you interested in the outcome of the project, reported here Nov. 11, of Ham Fisher's American comic strip character Joe Palooka to achieve "Muscle Powered Flight," he *was* successful. My forecast that the CycleWing inventor's shapely daughter wouldn't help the power-weight ratio proved right—she was replaced by Humph, a lusty volunteer, and he and Joe, achieving a pedal output of 1.9 h.p., got the device into the air. That done, they're passing to other problems. Pity they didn't enter the R.Ae.S.'s Kremer competition.

*

Derby Winner by Ten Lengths. "Herald Series 200. Powerplant: As 100, except length, 75 ft. 5 in."—*From a technical journal.* This must be the new Super-Dart with re-heat . . . re-heat . . . re-heat. . . .

*

Latham's Private Air Force. At the presentation of the Air Public Relations Association's *C. P. Robertson Trophy* to Sqn. Ldr. Peter Latham, Treble-One Squadron's C.O., he told me how delighted he and Mrs. Latham were when after four female additions to the family, their first son arrived. They were beginning to think that though heir-minded, they were not heir-conditioned.

*

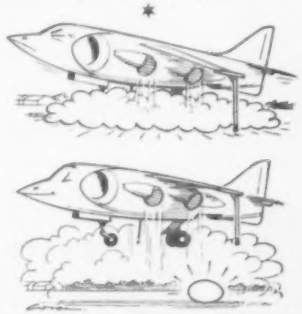
Line Shot

A Beverley, modified for supply-dropping, had just taken off from a M.E.A.F. airfield when the duty controller noticed that the huge rear doors were missing. Unaccustomed to this dreadful sight, he frantically told the pilot of the "emergency." The latter, with customary Transport Command aplomb, replied: "Thanks—we can't get our wheels up either."

*

Convairiety. Readers who like to be able to distinguish between the various American jetliners should be grateful to Convair for their 600 (how does 600 manage to come *after* 880?). Obviously designed and named by their publicity department, two large "speed capsules" have been nailed on to the trailing edge of each wing. The engineers were delighted to find that the excrescences actually added speed to the vessel *and* made good fuel tanks. Now it's up to Boeing and Douglas to cap Convair's capsules.

*



by Gwen

Industry Record

Rapid Film Processing

At the recent Industrial Photographic and Television Exhibition at the Albert Hall Kelvin Hughes displayed two models of their rapid continuous film processors. Based on the company's original military equipment designed to provide a large bright screen display of radar images photographed from a cathode-ray tube, these commercial processors are suitable for 16-, 35- or 70-mm. film.

The first model—35/70 RP.1—is intended essentially for 35- or 70-mm. negative processing at a film speed of 10 ft./sec. and has a dry-to-dry processing time of 30 sec. Model 16/35 RP.1 has a film speed of 40 ft./min., with a dry-to-dry processing time of 60 sec. It is suitable for either negative or positive processing of 16- or 35-mm. film.

Dagenite Batteries

A new catalogue, describing the wide range of Dagenite aircraft batteries, has been published by Pritchett & Gold and E.P.S. Co., Ltd., Dagenite Works, Dagenham Dock.

The illustrated catalogue contains comprehensive information on civil and military aircraft batteries, including notes on construction, specification and capacity. The latest 24-v. range for the D.H. Trident and Comet, Vickers VC 10, Vanguard and Viscount, Handley Page Herald and Fokker Friendship is described in full and there are also details of Dagenite 12-v. batteries which are suitable for use on both non-aerobatic and aerobatic aircraft.

Flexible Fuel Bags

Fireproof Tanks, Ltd., of Portsmouth are producing 5-gal. flexible drop bags made from Hycar nitrile rubber. These containers are designed to withstand rough treatment and filled bags may be jettisoned from aircraft flying at up to 130 knots at 100 ft. with complete recovery.

The bags measure 17 in. by 10 in. dia., and have a wall thickness of 0.06 in. When empty they weigh 2 lb. and it is stated that they can be folded and stored easily and economically in limited spaces, without the usual risks associated with metal fuel containers. A special feature of the bag is a quick-release sealing method—the intake tube is folded back once and a metal clamp placed over the double thickness.

New Distributors

Aero Electronics, Ltd., of Gatwick Airport, have been appointed the exclusive export agents and sole distributors to U.K. aircraft manufacturers of Communications (Air), Ltd., Bagshot, who manufacture a wide range of aeronautical electronic equipment.

Glide-path Indicator Lamps

The A.E.I. Lamp and Lighting Co., Ltd., has received a three-year Air Ministry contract to supply visual glide-path indicator (V.G.P.I.) lamps. Eight hundred of these sealed-beam lamps have already been supplied and the contract may eventually exceed 6,000.

The R.A.F. is installing this R.A.E.-developed visual approach aid on all its airfields and it is to be used at all major British civil airports. In the United States the V.G.P.I. system has been evaluated and recommended by the National Aviation Facilities Experimental Center and subsequently adopted by the F.A.A. as a standard civil landing aid.

Thunderbird's Nose-cone

The manufacture and testing of the radome that forms the nose-cone of an English Electric Thunderbird GAM is the subject of a new industrial film. Entitled "Spearhead of a Thunderbird," it has been produced by the Publicity Department of Bakelite, Ltd., as one of a pair of films designed to stimulate interest in reinforced plastics among potential users of the material.

Opening with a shot of an actual launching of the missile, the film then moves to the factory where the nose-cone is manufactured. This process starts with the pulling of a number of specially knitted glass-fibre "stockings" over a radome-shaped inner mould until the correct thickness has been built up. Polyester resin is then weighed out and precisely measured amounts of catalysts and accelerator are added, thereby starting a chemical action which will cause the liquid resin to cure after a given interval.

An outer mould is then placed in position, a vacuum line is connected to the top of the double mould and the resin poured in a trough at the bottom is forced up by atmospheric pressure, impregnating the glass fibre. When the resin appears in a sight glass on the top of the mould the flow is stopped and after hardening the radome is ready for finishing and testing.

After the first tests, in which measurements are taken of the electrical thickness of the radome wall, resin is sprayed on to make up any deficiencies, the amount sprayed being controlled by a punched tape record of the test. Wireless aberration tests are made for sight errors, the radome being mounted above a receiver facing a transmitter some distance away. Fitted with a plastic tip and base ring the radome is ready for mounting on a missile which, in the film, is then seen fired on trial against a drone target aircraft.

Produced in colour, this 16-mm. film shows a number of interesting techniques which many people will not have seen before. It has a running time of 18 min. and is available on loan from the Bakelite Publicity Department at 12-18 Grosvenor Gardens, London, S.W.1.

A typical set of English Electric Thunderbird radome moulds illustrated in one of the new Bakelite films on reinforced plastics. The set comprises a cast aluminium inner mould with built-in hydraulic ejection (left) and glass-fibre outer mould.

Aviation Calendar

Dec. 9

London.—R.Ae.S. Man Powered Aircraft Group lecture, "Aerodynamic Problems of Man Powered Flight," by T. R. F. Nonweiler, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

Dec. 10

Birmingham.—British Interplanetary Society Midlands Branch lecture, "Legal Problems in the use of Outer Space," by J. A. Andrews, in the Birmingham and Midland Institute Cinema, Paradise Street, at 18.30 hrs.

Dec. 12

London.—R.Ae.S. Historical Group lecture, "Some Problems of Aeronautical History," by C. H. Gibbs-Smith, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

Dec. 14

London.—R.Ae.S. Graduates' and Students' Section lecture, "B.O.A.C. and the Future," by C. Abell, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.30 hrs.

Dec. 15

Prestwick.—R.Ae.S. Glasgow Branch lecture, "Light Aircraft in General," at Scottish Aviation, Ltd., at 19.30 hrs.

London.—R.Ae.S. lecture, "Economic Lessons from Short-haul Operations," by S. F. Wheatcroft, in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

Dec. 20

London Airport Central.—Institute of Transport West Middlesex Group lecture, "Organization and Methods Work in Air Transport," by P. Garner and D. Hollings, in the 3rd floor Conference Room, Control Tower, at 18.30 hrs.

Company Notices

NEW COMPANIES

CAMBARIA (AIRCRAFT SPARES), LTD. (675,602).—Private co. Reg. Nov. 21. Cap. £100 in £1 shs. Aeronautical engineers, manufacturers and repairers of and dealers in aeroplane engines and parts. Sol.: Peters and Peters, W.1.

AIR RENT, LTD. (675,768).—Private co. Reg. Nov. 23. Cap. £100 in £1 shs. Aircraft for hire, etc. Secs.: Thomas A. Herbert.

CHANGES OF NAME

Airwork, Ltd. (233,961).—35 Piccadilly, W.1. Name changed to British United Airways, Ltd., on May 19, 1960.

United Airways, Ltd. (299,308).—35 Piccadilly, W.1. Name changed to Airwork, Ltd., on May 19, 1960.

New Patents

APPLICATIONS ACCEPTED

859,055—**General Electric Co.**—"Aircraft flight control systems."—Sept. 27, 1957. (Oct. 1, 1956.)

859,130.—**Soc. Nationale d'Etude et de Construction de Moteurs d'Aviation.**—"Stabilized control of aircraft in vertical flight."—Apr. 11, 1958. (Apr. 15, 1957.)

859,136.—**Blackburn Group, Ltd.,** formerly **Blackburn and General Aircraft, Ltd.,** and **Gadd, R. C. S.**—"Probes for use in refuelling aircraft in flight."—Jly. 14, 1959. (Addition to 828,632.)

859,007.—**Matthewman, W.,** and **Williams, E. H.**—"Thrust and/or lift producing devices for use in a fluid medium."—Oct. 22, 1958. (Jly. 23, 1957.) (Cognate applications 36563, Nov. 23, 1957, and 36564, Jan. 1, 1958.)

859,057.—**Baxter, Woodhouse and Taylor, Ltd.**—"Insulation and ventilation of aircraft."—Dec. 15, 1958. (Dec. 14, 1957.)

Printed specifications of the above will be available on Jan. 18, 1961, and the opposition period will expire on Apr. 18, 1961.

Personal Notices

BIRTHS

Clee.—On Nov. 21, at Fulford, York, to Josephine (*née* Allonby), wife of Flt. Lt. P. Clee—a daughter.

Slatter.—On Nov. 22, at R.A.F. Wegberg, to Freda (*née* Till), wife of Flt. Lt. Lloyd Slatter—a daughter.

DEATH

Perring.—On Nov. 24, Sqn. Ldr. Leslie Perring.

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Design effort at Warton is at present concentrated on the T.S.R.2 Strike Aircraft, and continued development on new versions of the Lightning Fighter. The tremendous Supersonic experience already gained, exemplified by our new Mach 4 Wind tunnel facility, is being utilised on civil aircraft designs in the Projects Office, where VTOL aircraft and ground effect machines are also under consideration. The problems known and still to be formulated are causing expansion of the technical departments and have created vacancies at all levels, but especially for men in their late twenties and early thirties who have at least five years' experience of aircraft development and design.

English Electric Aviation offers excellent prospects, security of employment, generous pension scheme and progressive salary scales, all of which can be discussed during interview. Removal and, in some cases, separation allowances will be made.

AERODYNAMICISTS AND AEROELASTICIANS

For research into fundamental ideas and phenomena associated with aircraft of the future, or work on problems associated with current designs, or aerodynamic studies of project aircraft. The research will receive full backing from our wind tunnels. Supersonic experience would be of considerable value for some of these positions.

PROPULSION ENGINEERS

For work on the mixed propulsion/lifting problems associated with VTOL, STOL and GEM's.

ENGINEERS AND STRESSMEN

Are required for work on new stressing techniques: thermal stressing: initial structural design or airworthiness engineering, in addition to vacancies for advanced detail stressmen.

SYSTEMS ENGINEERS

To initiate the design of hydraulic, fuel, or air systems. Environmental and heat transfer specialists are also required.

These vacancies are in the advanced projects office and the two project departments controlling the T.S.R.2 and Lightning Aircraft as well as the Engineering Departments concerned.

Warton is on the coast a few miles north of industrial Lancashire, located in very pleasant market gardening country only an hour or two's drive from the magnificent scenery of the Pennine Chain and Lake District. Nearby Blackpool offers entertainment unequalled outside London.

Please write giving details of qualifications and experience to Dept. G.P.S., English Electric House, Strand, London, W.C.2, quoting reference A/1796P.

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564-19

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THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM DAN-AIR SERVICES, LTD., OF 36-38 NEW BROAD STREET, LONDON, E.C.2, for the following Normal Scheduled Services, unless otherwise stated, with Dove, Dakota, Bristol 170 and Ambassador aircraft, for the carriage of passengers, supplementary freight and mail at a frequency of four return flights weekly on each service, for seven years from April, 1961:—

APPLICATION NO. 4638 between Shoreham and Ostend.

APPLICATION NO. 4639 on the route Cardiff and/or Swansea and/or Bristol and/or Plymouth.

APPLICATION NO. 4640 for a U.K. Internal Service on the route Newcastle and/or Liverpool and/or Cardiff and/or Swansea and/or Bristol-Shoreham.

APPLICATION NO. 4641 between London (Gatwick) and Ostend.

FROM NORTH-SOUTH AIRLINES, LTD., OF LEEDS AND BRADFORD AIRPORT, YEADON, LEEDS, for the following U.K. Internal Services with Heron and Herald aircraft, for the carriage of passengers, supplementary freight and mail at a frequency in accordance with traffic demand on each service for seven years from the date of approval:—

APPLICATION NO. 4642 between Leeds/Bradford and Birmingham.

APPLICATION NO. 4643 between Leeds/Bradford and Glasgow (Renfrew).

APPLICATION NO. 4644 between Manchester and Isle of Wight (Sandown).

FROM BRITISH UNITED AIRWAYS, LTD., OF 35 PICCADILLY, LONDON, W.1:—

APPLICATION NO. 3314/2 for an amendment to the terms of approval of the All Freight Service which they are authorized to operate with Viscount aircraft on the route London (Gatwick)-Dusseldorf-Hanover at a frequency of seven return flights weekly but without the right to carry mail or military freight, so as to enable them to operate on the amended route London (Gatwick)-Dusseldorf and/or Hanover, to substitute two return flights with DC-3 aircraft for any one return flight approved with Viscount aircraft and to carry mail (both civilian and Forces) and newspapers for the British and American Forces.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

564-1

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zzz-674

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zzz-740

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564-9109

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APPLY in writing to British United Airways, Ltd., Overseas Contracts Division, National Works, Bath Rd., Hounslow, Middx.

564-9118

RADIO engineer with A and B licences required to take charge of radio maintenance section as working foreman. Preferably with radar licence but not essential. Commencing salary £1,500. Apply in writing to Box A633, care of THE AEROPLANE AND ASTRONAUTICS.

565-9119

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APPLY Air Services Division, Pressed Steel Co., Ltd., Oxford Airport, Kidlington.

564-9111

DAN-AIR invite applications for employment at Lasham Airfield from experienced engine-airframe fitters and instrument mechanics.

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564-9116

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APPLY Personnel Manager, Western Airways, Ltd., The Airport, Weston-super-Mare.

564-2

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565-9122

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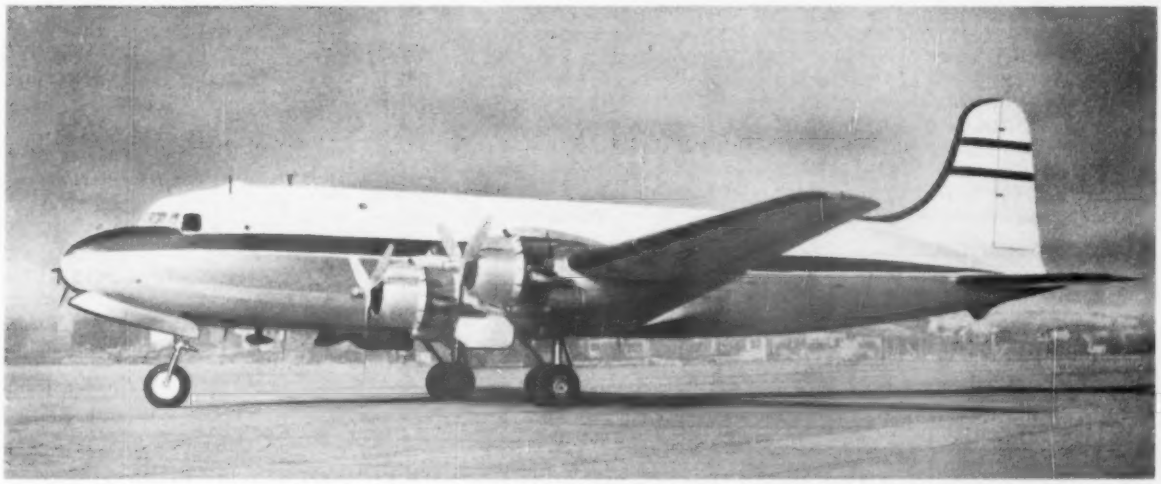

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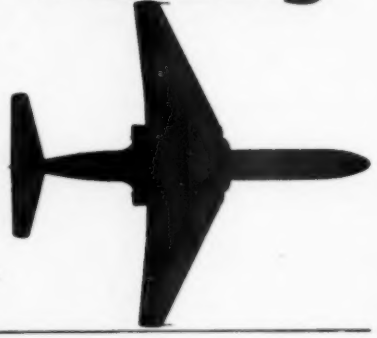

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INDEX TO ADVERTISERS

Name	Page
A	
Adcola Products, Ltd.	42
Aero-Enterprises (Boreham Wood), Ltd.	40
Alvis, Ltd.	22
Associated Electrical Industries, Ltd.	6
Attewell, B., & Sons, Ltd.	46
B	
Babcock & Wilcox Ltd.	44
Blackburn Engines, Ltd.	33
Blackburn Group, Ltd., The	Front Cover
Boeing Airplane Co.	1
B.P. Aviation Services	44
Bristol Siddeley Engines, Ltd.	30
British European Airways Corporation	44
British Institute of Engineering Technology	46
British Oxygen Aviation Services	32
British Timken: A division of the Timken Roller Bearing Co.	18
British United Airways	13
B.S.T. Aeronautical Co., Ltd.	46
C	
Canadair, Ltd.	7
Central Office of Information, R.A.F. Recruiting	45
Cross Manufacturing Co. (1938), Ltd.	42, 46
D	
De Havilland Aircraft of Canada, Ltd.	11
De Havilland Engine Co., Ltd., The	25
Dowty Rotol, Ltd.	Back Cover
Dunlop Rubber Co., Ltd. (Aviation Division)	26
E	
Ekco Electronics, Ltd.	34
Electro-Hydraulics, Ltd.	29
English Electric Aviation, Ltd.	39
E.N.V. Engineering Co., Ltd.	14
F	
Ferranti, Ltd.	20
Fletcher, C. W. & Sons, Ltd.	41
Flexible Ducting, Ltd.	Inside Front Cover
H	
Hawker Siddeley Aviation, Ltd.	28, 45
Helicopter Services, Ltd.	40
Holman & Co. (Engineers), Ltd.	41
Hymatic Engineering Co., Ltd., The	Inside Back Cover
J	
Jeppesen & Co. GmbH	41
K	
Keegan Aviation, Ltd.	43
M	
Marconi's Wireless Telegraph Co., Ltd.	2, 3
Marshall's Flying School, Ltd.	42, 46
Martin-Baker Aircraft Co., Ltd.	35
M.L. Aviation Co., Ltd.	12
N	
Napier, D., & Son, Ltd.	31
Newmark, Louis, Ltd.	9
P	
Palmer Aero Products, Ltd.	8
Phillips & White, Ltd.	41
Plessey Co., Ltd., The	23
Power Auxiliaries, Ltd.	4
Pressed Steel Co., Ltd.	42
R	
Rolls-Royce, Ltd.	27
Rotax, Ltd.	37
Rumbold, L. A. & Co., Ltd.	12
Rye, Claude, Bearings	46
S	
Sangamo Weston, Ltd.	34
Shackleton, W. S. (Aviation), Ltd.	40
Shell Aviation Services	17
Short Brothers & Harland, Ltd.	21
Silver City Airways, Ltd.	42
Solartron Electronic Group, Ltd., The	24
S.P.E. Co., Ltd.	14
Sperry Gyroscope Co., Ltd., The	36
Standard Telephones & Cables, Ltd.	10
Sud Aviation	15
T	
Teddington Aircraft Controls, Ltd.	38
U	
Ultra Electronics, Ltd.	5
V	
Vickers-Armstrongs (Aircraft), Ltd.	19
Vigors Aviation, Ltd.	40
W	
Westland Aircraft, Ltd.	16

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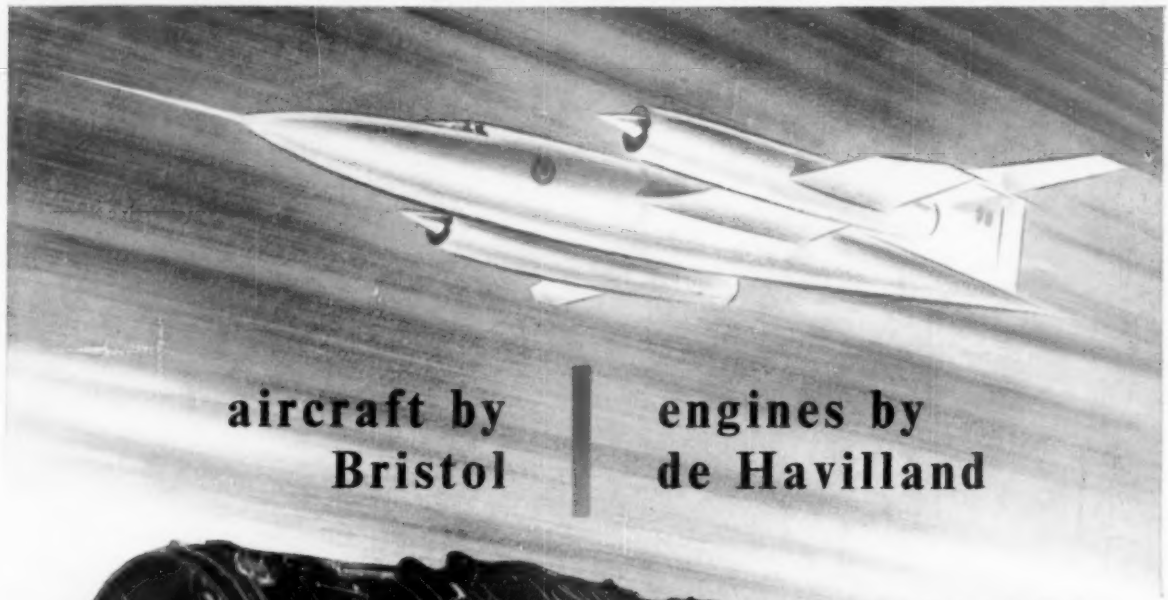

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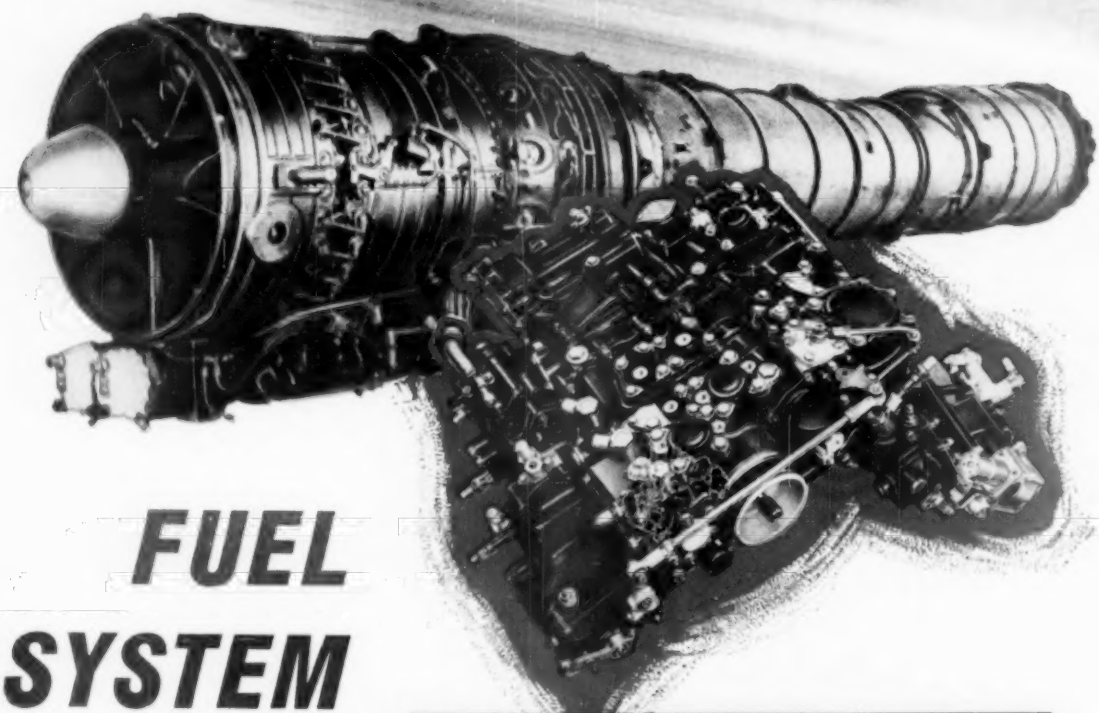

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